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Toronto-Buttonville Airport ▪ Markham, Ontario ▪ L3P 3J9 ▪ 416-477-8400

HALTON HILLS LANDFILL
1981 MONITORING REPORT

PROJECT No. 80-96-G

SEPTEMBER, 1982.

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September 21, 1982.

The Regional Municipality of Halton,
1151 Bronte Road,
Oakville, Ontario,
L6J 4Z3.

Attention: Mr. D.J. Corbett

Dear Sirs:

Re: Halton Hills Landfill
1981 Monitoring Program Report
GLAL 80-96-G

We are pleased to submit our 1981 monitoring program final report for the Halton Hills Landfill Site. Thank you for the opportunity to be of service. Do not hesitate to call if you have any questions.

Yours very truly,

GARTNER LEE ASSOCIATES LIMITED

Grant Anderson

E.G. Anderson, P.Eng.,
Consulting Hydrogeologist.

RCD:jcm

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1.0 CONCLUSIONS AND RECOMMENDATIONS:

1.1 CONCLUSIONS:

Based on the findings of this monitoring program the following conclusions are drawn:

- Landfill leachate is leaking into a storm sewer which runs beneath the landfill and discharges into the Credit River. Methane gas was detected in two catch basins of this same storm sewer as far as 140 m west of the site. The Region of Halton has located the leak with a television survey and plans to pressure grout it in 1982.

- The toe-drain leachate collection system has worked well and has significantly reduced leachate springs along the toe of the landfill. The system delivered 8,513 m^3 of leachate to the Georgetown sanitary sewer system in 1981. Flows were very high for the first three months after the system was put into operation but tapered off during the rest of the year.

- All the ground water monitors on-site are affected, to various degrees, by the landfill leachate. The quality of the leachate in the landfill and the affected ground water near discharge points along the Credit River has been characterized. The volume of leachate discharging to the river via the ground water flow system is very small.

- We have not detected any impact on the water quality

or aquatic organisms in the Credit River which is directly attributable to the landfill. Although we know small volumes of leachate discharge to the river via the storm sewer and via the ground water flow system, there is no detectible impact because of dilution. The flows in the river are much greater (1:80,000) than the volume of leachate discharged.

- Although high concentrations of methane gas exist within the landfill, gas does not migrate very far through the dense natural soils. Gas has however moved up to 140 metres off-site along the storm drain which runs beneath the landfill. Any porous underground conduit which intersects the refuse is a potential path for gas migration.

1.2 RECOMMENDATIONS:

We submit the following recommendations based on the study findings:

1. Water samples should be collected from the storm drain upgradient and downgradient from the landfill to determine if the landfill is responsible for the degraded water quality. Water samples should be collected from the storm drain before and after the pressure grouting to help determine if the leak has been plugged.

2. Gas monitoring should be continued at two month intervals until gas migration along the storm sewer

ceases. This monitoring will indicate whether or not the pressure grouting has solved the gas problem. If it does not we suggest that a gas venting system should be designed and installed on the storm drain along the west property boundary to prevent off-site gas migration.

3. Monitoring of water quality and aquatic organisms in the Credit River should be discontinued. Two years of water quality and biological monitoring has not detected any impact on the river from the landfill, due to the large dilution capacity.

4. Leachate samples will be taken twice a year from the lower pumping station and submitted to the M.O.E. for analysis. This will provide a representative average of leachate quality which will be useful in assessing the landfill-related loadings which will reach the Georgetown Sewage Treatment Plant.

5. We recommend that ground water monitoring be discontinued at this site. Leachate-contaminated ground water is discharging into the Credit River but the flow rates are so slow that there is negligible impact. This leachate plume appears to be in a steady state condition although seasonal variations in water quality do occur. There are no wells or ground water usages downgradient of the landfill. We feel that further ground water monitoring at this site would have very little purpose.

2.0 INTRODUCTION:

This report outlines ground water, surface water, gas and aquatic biological monitoring carried out at the Halton Hills Regional Landfill Site in 1981. This is an annual report of the ongoing monitoring program which was authorized by the Region of Halton in August 1980.

The purposes of this program are:

- to monitor the effectiveness of the leachate collection system;
- to better define possible impact of the site on water quality and use of the Credit River;
- to monitor the possible migration of explosive decomposition gases produced by the landfill; and
- to conform with requirements of the Ontario Ministry of the Environment regarding closure and rehabilitation of the site.

Previous work done on this site by Gartner Lee Associates was reported in the "Georgetown Landfill Leachate Impact and Control Study", November 1979; the "Georgetown Landfill Site Methane Migration Study", March 1979; and the "Halton Hills Regional Landfill Site Monitoring Program - Interim Report", May 1981.

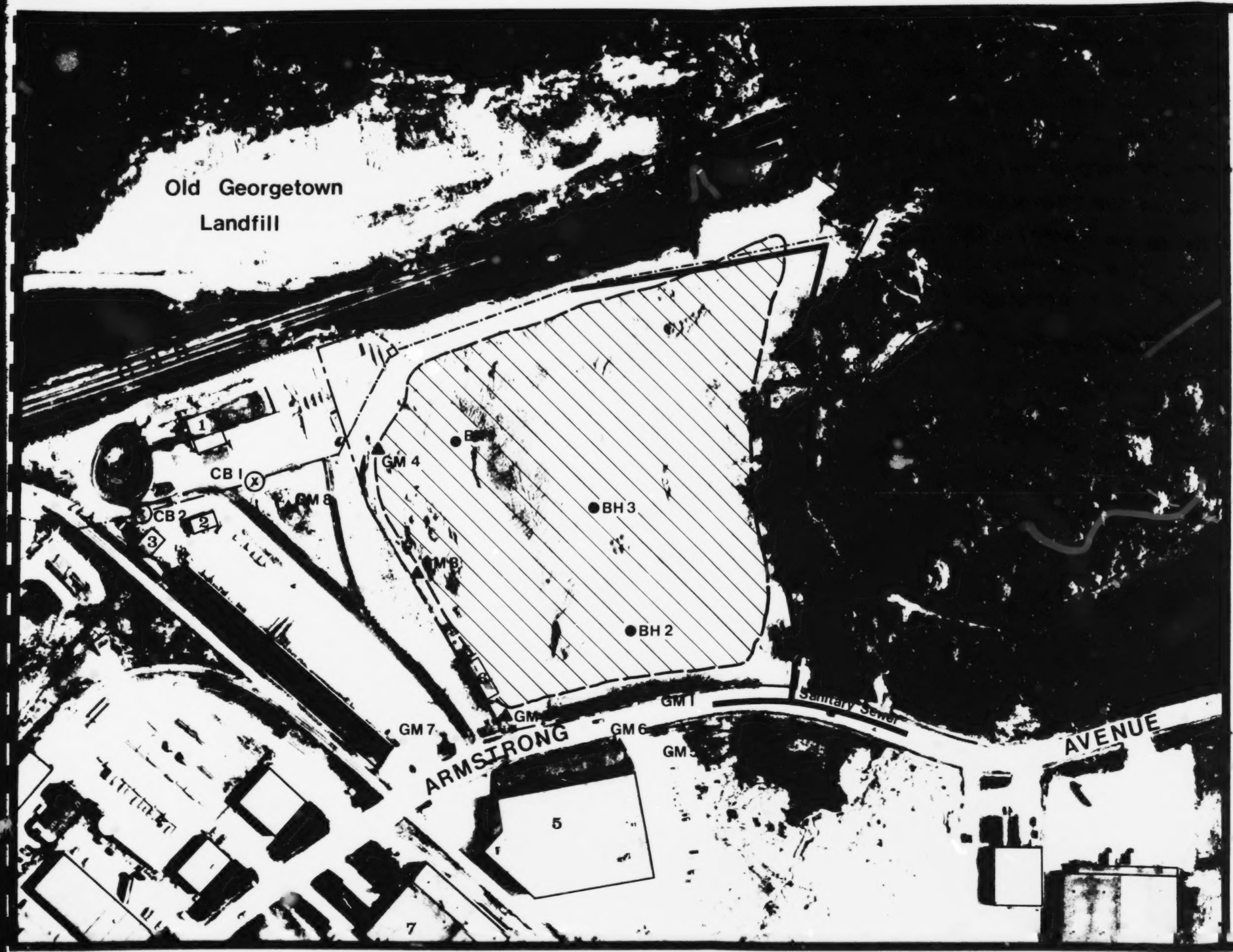
3.0 PROCEDURES:

Ground water and surface water samples were collected on April 7, May 22, October 14 and November 20, 1981 and submitted to the M.O.E. laboratory for chemical and bacteriological analysis. Ground water samples were collected from existing monitors on site with a stainless steel bailer. Ground water monitor locations are shown on the Site Plan, Figure 1.

Surface water samples were collected from five stations along the Credit River which are shown on Figure 2. One sample was also collected from the outfall of a storm drain which passes under the landfill and discharges into the Credit River.

Gas measurements were made during all site visits plus extra monthly visits during the winter of 1982. Gas measurements were made in existing gas monitors and ground water standpipes as well as in 4 new gas monitors. These monitors were installed by hand augering to depths of approximately one metre into the clayey silt till soils, just outside of the site boundaries in November 1981. Gas monitor locations are shown in Figure 1.

Bottom fauna organisms were sampled at Stations 1 through 4 on the Credit River once during the low flow conditions in the summer of 1981. Two artificial substrate baskets containing 3" crushed limestone were placed at each



Legend

Fig. 1

- ●BH 1 Gartner Lee Borehole Location
- ▲GM 1 Gartner Lee Gas Monitor Location
- ⓧCB Catch Basin

Building

- 1 ..... Red-D-Mix
- 2,3,4,5 ... Elliot Custom Brokers
- 6 ..... Guard House
- 7 ..... Inmont

- Area of Landfilling (approx.)
- Leachate Collection System
- 18 inch Storm Sewer
- Property Boundary

Scale
0 20 40 60 80 100
METRES
Approximately 1 to 2000

N

Site Plan

HALTON REGION
HALTON HILLS LANDFILL

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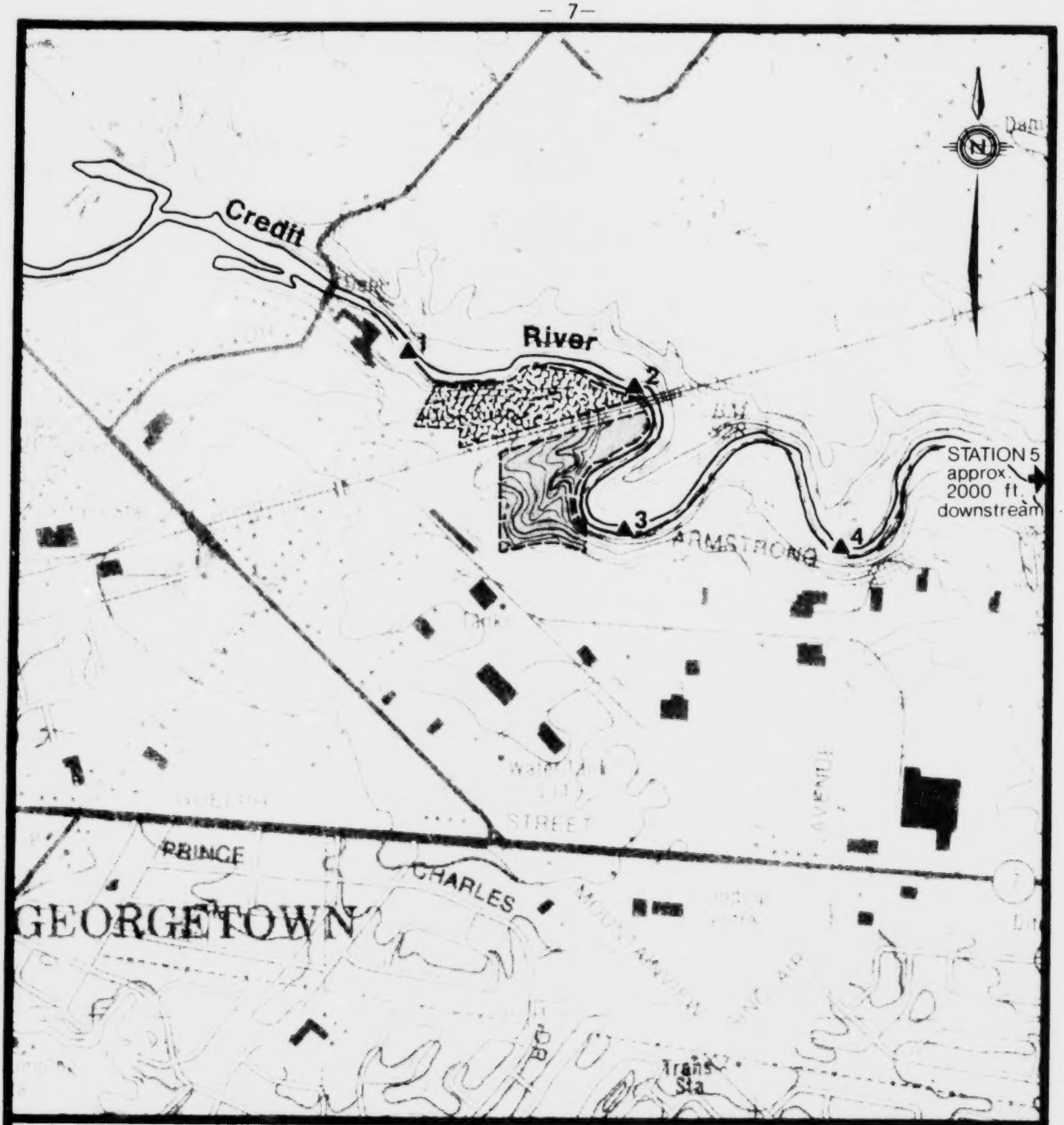

FIGURE 2: Surface Water Monitoring Stations

Georgetown Landfill Investigation

LEGEND

- Abandoned Landfill
- Georgetown Landfill
- ▲1 Surface Water Sampling Station

Scale 1:12500

0 500 METRES

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station on August 13, 1981. This is the same approach used in the fall of 1980 during high flow conditions to overcome the problem of widely varying bottom types at the four locations. Roughly six weeks later, on September 24, 1981 the baskets were recovered. The organisms which colonized the baskets were sorted, identified, enumerated and preserved in 95% ethanol. Bottom fauna associations inhabiting the baskets were related to water quality status and possible response to inputs from the landfill. In this way, effects on aquatic life, not revealed through chemical testing, would be monitored.

During monitoring field visits, observations were made of leachate springs, runoff, erosion, vegetation, and the performance of the toe-drain leachate collection system.

4.0 RESULTS AND DISCUSSION:

4.1 BACKGROUND:

The Halton Hills landfill is located in the Georgetown light industrial area. The site is bounded to the north by the CN Railway, to the east by the Credit River, to the south by Armstrong Avenue and to the west by Red-D-Mix Concrete property. The site is approximately six hectares in size.

Before landfilling, two sandfilled stream valleys intersected the property and drained into the Credit River. The river in the vicinity of the site has deeply dissected both surficial deposits and shale bedrock. The west bank of the river just south of the landfill is a very steep cliff with a near vertical drop of over 35 m. Shale bedrock outcrops along the valley wall. Erosion is an active process in this area of steep topography and relatively soft geologic materials.

The main surficial deposit in this area is dense clayey silt Halton Till. Along the flood plain of the Credit River and presumably along the two stream valleys which have since been covered with garbage, the till has been eroded and in its place remains a thin layer of recent alluvial clayey silt, sand and minor gravel. Beneath the till there are thin lenses of older sandy alluvial materials. These lenses are of variable thickness and grain size, and are probably not continuous across the entire site.

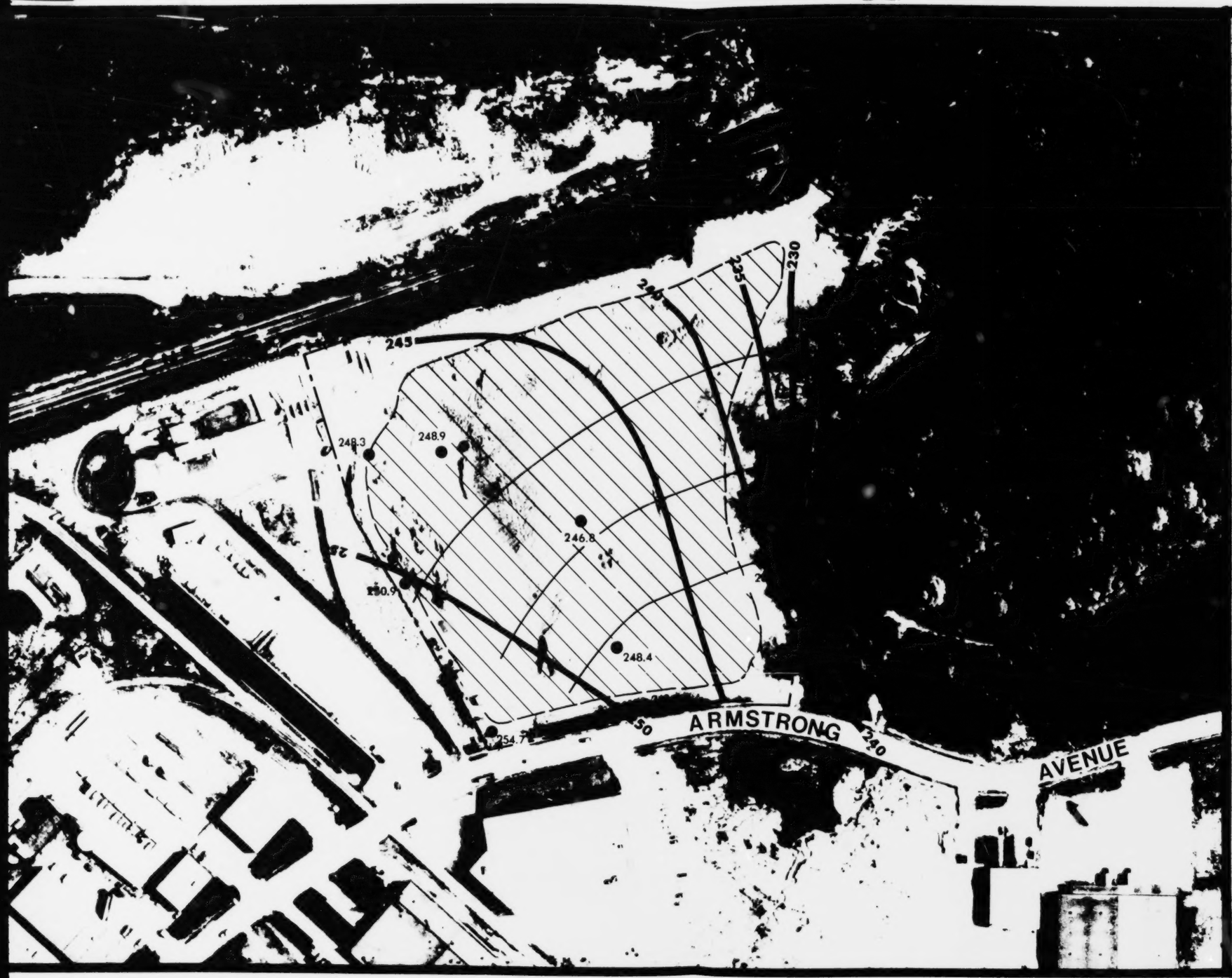
Below this lies the Upper Ordovician Queenston Shale. The Queenston Shale comprises thinly bedded red shale with numerous interbeds of indurated, calcareous siltstone. The bedrock dip is sub-horizontal and numerous vertical joints are present. In places the upper metre of the shale has a weathered, disturbed appearance denoted as shale-till complex in the borehole logs.

Landfill operations ceased in 1979. A final cover of between 0.3 m and 1.5 m of clayey silt fill was placed over the site and a new toe-drain leachate collection system installed in 1980. The leachate collection system went into operation in January 1981.

4.2 GROUND WATER:

All ground water measurements made to date are presented in Appendix I. The water table configuration and ground water flow directions as of October 13, 1981 are shown on Figure 3. Ground water flow is toward the Credit River to the east.

Figures 4 to 9 (Appendix I) are hydrographs of water levels in boreholes 1 to 6. Strong downward gradients exist in boreholes 1, 2, 3 and 6 which are located in the uplands areas. Boreholes 4 and 5 on the flood plain of the Credit River show small downward gradients. Seasonal variations in water levels are generally within a range of about one metre except for monitors 3-I and 5-I where water level changes of up to three metres have



Legend

Fig. 3

- Area of Landfilling (approx.)
- 235.6 Observation Point and Water Table Elevation (Oct. 13, 1981)
- 220 Inferred Ground Water Table Contour (Oct. 13, 1981)
- Probable Shallow Ground Water Flow Direction
- Property Boundary

Scale

0 20 40 60 80 100

METRES

Approximately 1 to 2000

N

Water Table Configuration

HALTON REGION

HALTON HILLS LANDFILL

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been observed. The average ground water flow rate through the shale is estimated to be about two metres per year.

The subject site is within an area which is serviced by the Georgetown municipal water supply system and there are no wells or ground water usages downgradient of the landfill. The main concern at this site, is the effect of ground water contamination when it finally discharges into the Credit River.

All ground water quality analyses are presented in Appendix II. Table 1 summarizes the 1981 water quality concentration ranges of leachate and ground water at this site. Monitors 1-II, 2-II and 3-II are standpipes screened in the refuse and along with the pumping station samples they characterize the quality of "raw" leachate. Monitors 1-I, 2-I and 3-I are piezometers screened in the shale directly beneath the refuse. The samples from these monitors are not as poor quality as "raw" leachate but all of them are affected by leachate contamination.

Monitors 4-I, 4-II, 5-I, 5-II, 6-I and 6-II are all screened in natural geologic materials (either shale or alluvial sands and gravels) downgradient of the landfill. They all exhibit leachate contamination to various degrees. This is to be expected. The toe-drain at this site is designed to prevent leachate springs from developing at the toe but is not intended to intercept all leachate contaminated ground water flow. The water quality in these wells is better for many parameters than that of

TABLE 1: 1981 Water Quality Concentration Ranges of Leachate and Ground Water

	"Raw" Leachate in Refuse (BH 1-II, 2-II, 3-II and Pumping Station)	Leachate in Bedrock Beneath Refuse (BH 1-I, 2-I, 3-I)	Leachate Contaminated Ground Water Near Discharge Area (BH 4, BH 5, BH 6)
Conductivity	1500-9000	800-1600	1200-6000
Hardness	500-2500	300- 700	500-1800
Alkalinity	700-3500	300- 850	300-1700
Chlorides	100-1000	10- 150	250- 950
Sulphates	5- 60	50- 160	10-1700
Total Kjeldahl Nitrogen	15- 450	.5- 18	.5- 35
Total Iron	40- 600	1.0- 90	1.0- 420
BOD	40-2300	1.0- 125	.5- 160
COD	80-4000	25- 240	20- 460

raw leachate. This is due to dilution and the natural geochemical processes which attenuate and renovate the leachate as it migrates through the ground water flow system.

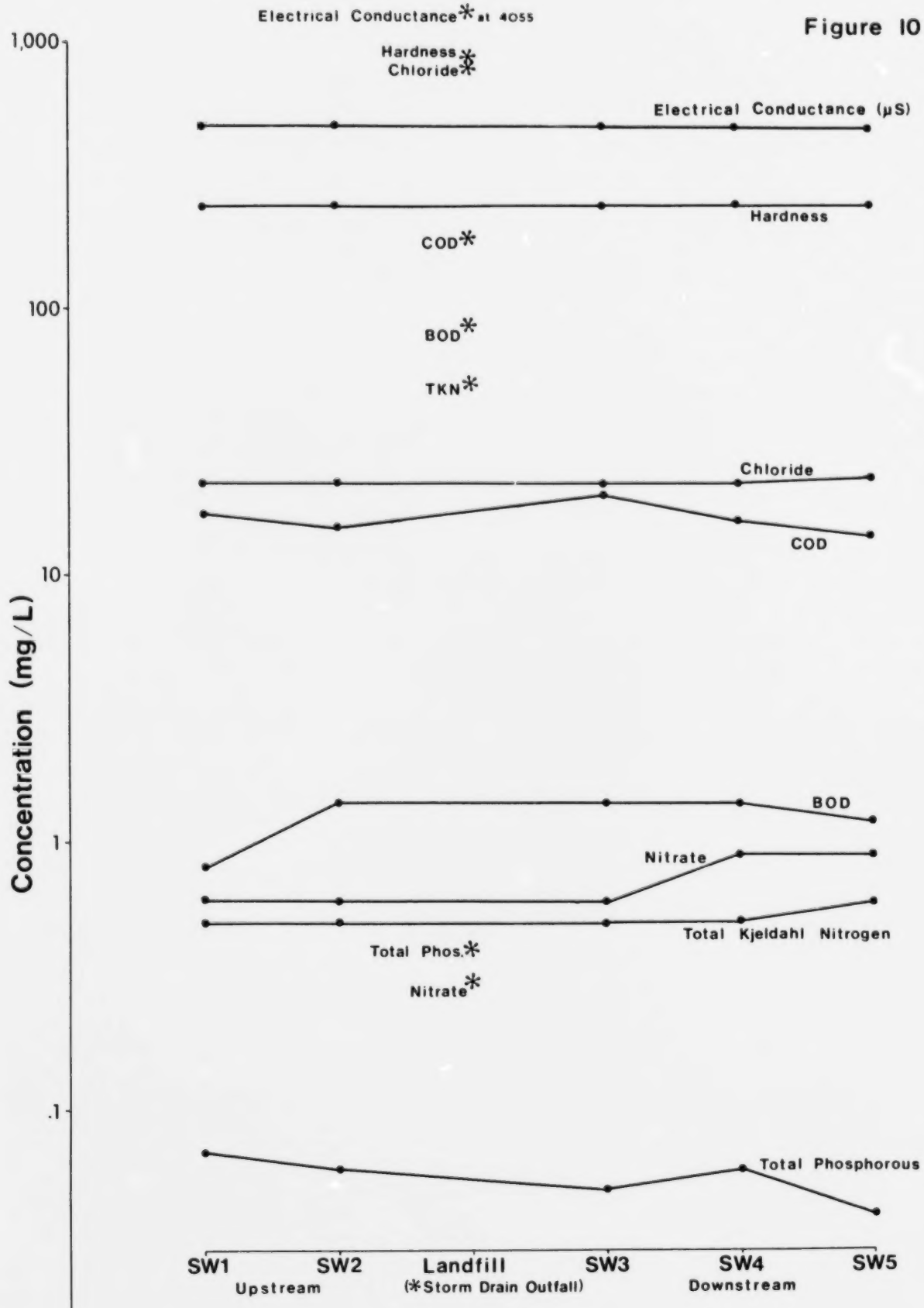
In our 1980 monitoring report we calculated a worst case dilution of 1:80,000 by dividing the historical low flow in this stretch of the Credit River by the calculated discharge of leachate from the landfill to the river via the ground water flow system. Because of this large dilution factor the leachate contaminated ground water discharges have no detectable effect on the Credit River. This theoretical calculation is confirmed with surface water quality data and aquatic biological studies presented in the following sections.

4.3 SURFACE WATER:

Surface water samples were collected from the five sampling stations on the Credit River shown in Figure 2. Stations SW1 and SW2 are upstream of the landfill and SW3, SW4 and SW5 are downstream. Samples were also collected at the outfall of a storm sewer which runs beneath the landfill and discharges into the Credit River between SW2 and SW3. Another storm sewer discharges into the river between SW4 and SW5.

Surface water quality and bacteriological analyses are presented in Appendix II. Figure 10 shows the 1981 mean concentrations for selected water quality parameters

Figure 10



SURFACE WATER QUALITY. 1981 Means (mg/L)
CREDIT RIVER - HALTON HILLS LANDFILL Project 80-96-G

Figure 11

SURFACE WATER BACTERIOLOGICAL ANALYSIS. 1981 Geometric Means (counts per 100 ml) Credit River – Halton Hills Landfill

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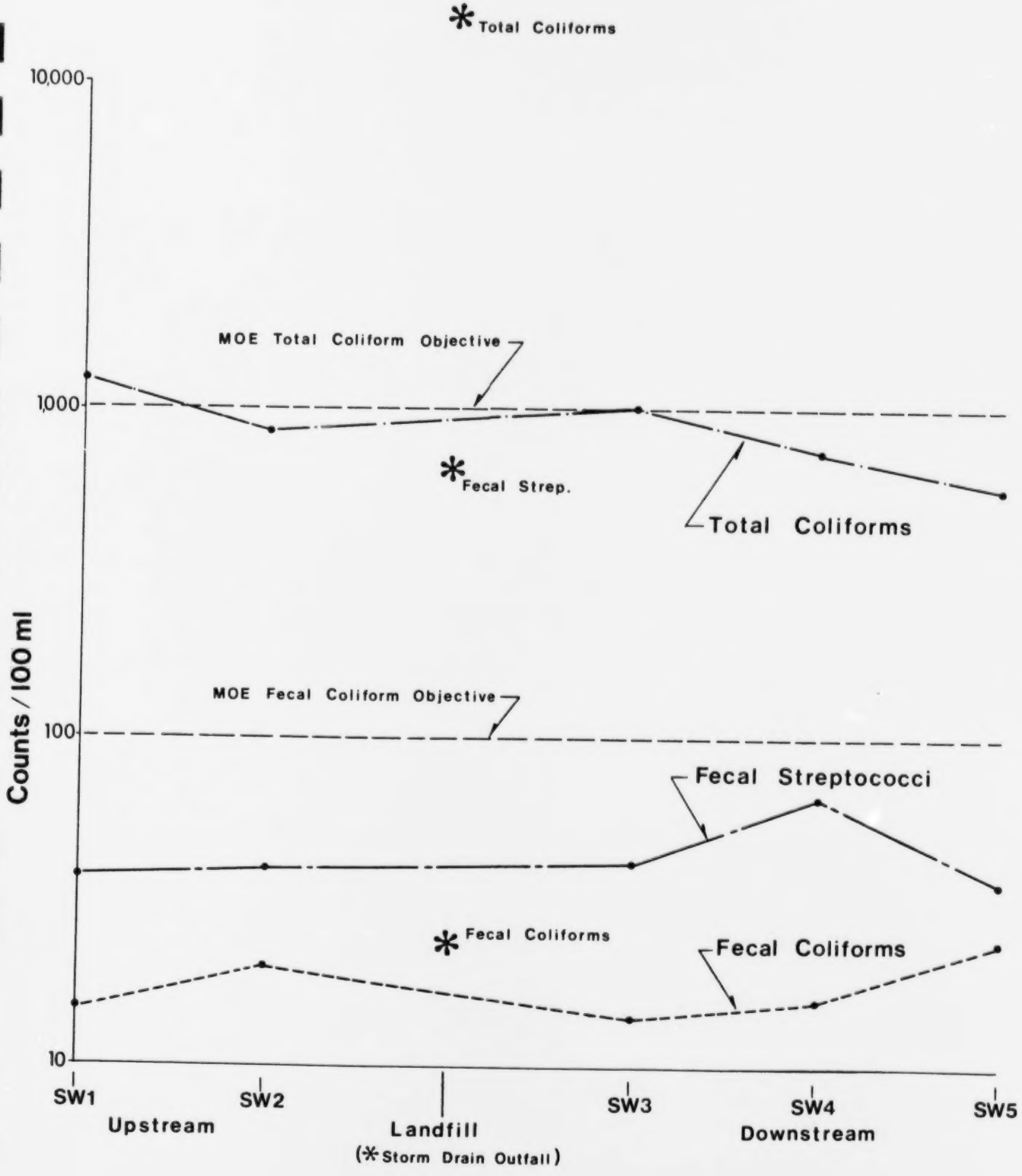

plotted versus sampling station locations. Figure 11 is a similar plot with the 1981 geometric means of bacteriological analyses. These figures illustrate that there is no detectable decrease in water quality past the landfill.

The 1981 mean water quality for the storm drain which runs beneath the landfill is also shown on Figures 10 and 11. The water in the drain exceeded M.O.E. objectives and criteria for chlorides, total phosphorous, organic nitrogen, un-ionized ammonia, and iron in 1981. The drain water appears to be contaminated with leachate and is of much poorer quality than the river water. The Region of Halton did a television survey of the drain in 1981 and detected a leak beneath the landfill. This leak will be pressure grouted in 1982. Additional water samples will be collected from the drain above and below the landfill during 1982 to ensure that the cause of contamination is the landfill and to make sure the pressure grouting has successfully plugged the leak.

A sample from the drain collected on March 22, 1982 during spring runoff, has much better quality than the 1981 samples. This is due to the large dilution from runoff waters collected upgradient of the site.

In summary, leachate is slowly discharging through the ground water flow system to the Credit River.

Leachate also discharges to the river via a leak in the

storm drain which runs below the landfill. However, the impact on the Credit River is not detectable because the volume of leachate discharging is much less than the volume of flow in the river.

Results of bottom fauna sampling are provided in Table 8 of the Appendix.

As in 1980, only subtle differences were noted among the bottom fauna associations at each station. These differences are as likely to be the result of minor variations in habitat among the various sampling sites as to inputs from the abandoned Halton landfill.

Stonefly, mayfly and caddisfly larvae -- all clean-water forms -- were well represented at all sampling sites. In fact, these groups dominated the numbers of organisms found on the artificial substrates at all stations. They constituted between 35 and 62% of the total taxa found at each station.

No evidence of fouling or iron-staining of the substrate rocks was noted during the bottom fauna sampling effort.

Bottom fauna populations in the Credit River downstream from the Halton Hills landfill do not appear to be affected by possible leachate inputs from the abandoned site.

4.4 GAS:

All measurement of combustible gas made to date are presented in Table 2. Standpipes BH1-II, BH2-II and BH3-II, and gas monitor GM4 are all screened in the refuse. As expected, they all have consistently high gas levels which exceed the explosive limit for methane of 5%.

Gas monitors GM1, GM2 and GM3 are screened in sands and silt till and are located several metres beyond the edge of the filled refuse. These monitors occasionally have greater than 5% combustible gas, but most of the time have lower levels.

Four new gas monitors (GM5 to GM8) were installed in the fall of 1981 and monitored monthly from December 1981 to April 1982. These monitors are about 25 to 50 m from the edge of the fill. No gas has been detected in any of these monitors.

The gas monitoring data collected to date suggests that there is a considerable concentration of gas within the refuse but it only migrates a short distance from the landfill. The dense natural till soils prevent gas from migrating any significant distance.

Two catch basins (CB1 and CB2 - see Figure 1) along the storm drain were checked for gas during this study. These catch basins are upgradient and about 50 m and 140 m west

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HALTON HILLS LANDFILL
COMBUSTIBLE GAS CONCENTRATIONS

TABLE 2 **SHEET** 1

BOREHOLE NUMBER	MONITOR No.	MONITOR Type	Feb.15 1979	Mar.29 1979	Oct.1 1980	Oct.6 1980	Oct.27 1980	Nov.18 1980	Dec.4 1980	Jan.12 1981	Mar.24 1981	Apr. 7, 1981	May 22, 1981
BH 1	I	●						0%	0%				
	II	▲				15%		55%	35%		65%		70%
BH 2	I	●						0%	0%				
	II	▲				10%		4.5%	15%		40%		40%
BH 3	I	●						0%	0%				
	II	▲				45%		60%	20%		55%		60%
BH 4	I	●						0%	0%				
	II	▲						0%	0%		0%		-
BH 5	I	●						0%	0%				
	II	▲						1%	0%		0%		-
BH 6	I	●						0%	0%				
	II	▲						0%	0%		0%		-
G.M.1	I	▲	0.4%	0.8%	5%	0%	5%	0%	0%	5%	.5%	5%	10%
G.M.2	I	▲	0.1%	0.3%	0%	0%	0%	0%	0%	0%	0%	0%	0%
G.M.3	I	▲	0.0%	0.05%	9%	5%	2%	13%	10%	>6%	.5%	5%	1%
G.M.4	I	▲			70%	45%	60%	55%	30%	>6%	65%	65%	65%
Red-D-Mix Catch Basin								1%		1.3%	3.5%	-	0%

● – Piezometer ▲ – Standpipe

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HALTON HILLS LANDFILL
COMBUSTIBLE GAS CONCENTRATIONS

TABLE 2 **SHEET** 2

BOREHOLE NUMBER	MONITOR No.	MONITOR Type	Oct.13, 1981	Nov.18, 1981	Dec.14, 1981	Jan.21, 1982	Feb.17, 1982	Mar.22, 1982	Apr.8, 1982				
BH 1	I				0	0	0	0	0				
	II		60	0.5	55	65	55	-	55				
BH 2	I				0	0	0	0	0				
	II		70	15	35	40	35	35	35				
BH 3	I				0	0	0	0	0				
	II		70	50	70	70	35	60	70				
BH 4	I					0	0	0	0				
	II					0	0	0	0				
BH 5	I					0	0	-	-				
	II					0	0	-	-				
BH 6	I					0	0	0	0				
	II					0	0	0	0				
G.M.1			> 6	4.8	5	5	1.5	5	1				
G.M.2			0	0	0	0	8	20	5				
G.M.3			> 6	0	0	5	Buried under snow		10				
G.M.4			50	50	55	70	65	80	80				
G.M.5					0	0	0	0	0				
G.M.6					0	0	0	0	0				
G.M.7					0	0	0	0	0				
G.M.8					0	0	0	0	0				
CB1			4	0.8	1.0	2	1.5	2	0.75				
CB2				0	1.0	1.5	buried under snow		0				
CB3						-	-		-				

● – Piezometer ▲ – Standpipe

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of the refuse. Gas concentrations of up to 4% have been detected in CB1 and up to 1.5% in CB2. Since methane is lighter than air it would be expected to migrate upgradient in the drain. The leachate leaking into the storm drain below the landfill may be responsible for the presence of gas in these catch basins.

Five other catch basins along this storm sewer, upgradient of CB2 were also checked for combustible gas four times during the winter of 1982. No gas was detected.

Although gas migration through the dense natural soils does not appear to be a problem, it should be noted that there is potential for gas movement off site along any porous conduit which intersects the refuse, such as the granular backfill which is placed in trenches for drains, sewers, water mains, or underground electrical conduits.

4.5 LEACHATE COLLECTION SYSTEM:

The original leachate collection system was found to be in poor repair and operating inefficiently in 1979. It was replaced with a new system in the fall of 1980 and was put into operation in January, 1981. The system consists of a toe-drain along the eastern perimeter of the fill and a two stage pumping system which discharges into the Georgetown sanitary sewer system.

The lower pumping station has two pumps, each rated at 12.26 m^3/hour (54 US gpm). The upper pumping station has two pumps rated at 14.53 m^3/hour (64 US gpm). Regional staff record the cumulative hours pumped each week.

In order to determine the total volume of leachate pumped in 1981, we took the cumulative hours of pumping for both wells in the upper pumping station from start up in January 1981 to December 29, 1981, and multiplied by the pumping rate

Leachate pumped in 1981 =

585.9 hours x 14.53 m^3/hour = 8513 m^3.

A water budget was prepared for this site for a previous report based on 30 year normal climate data obtained from the Georgetown Climatic Station. The potential evapo-transpiration was calculated using the Thornthwaite Method.

A net annual gain of 23.8 cm was calculated. In this area the actual evapotranspiration is generally about 10 cm less than the potential calculated by the Thornthwaite Method. Thus the actual annual water surplus available for infiltration and runoff is about 33.8 cm.

We have estimated a runoff coefficient of 0.70 based on the low permeability clay final cover on top of the site and the relatively steep slopes. This means that on average 23.7 cm runs off and 10.1 cm (0.03 L/sec/hectare) infiltrates. If we assume that all leachate produced is from this infiltration we can calculate a total rate of leachate production for the entire 6 hectare site of 0.18 L/sec (15.6 m^3/day) which equates to 5694 m^3/year. The calculated volume of leachate production is nearly 3,000 m^3 less than the actual volume pumped.

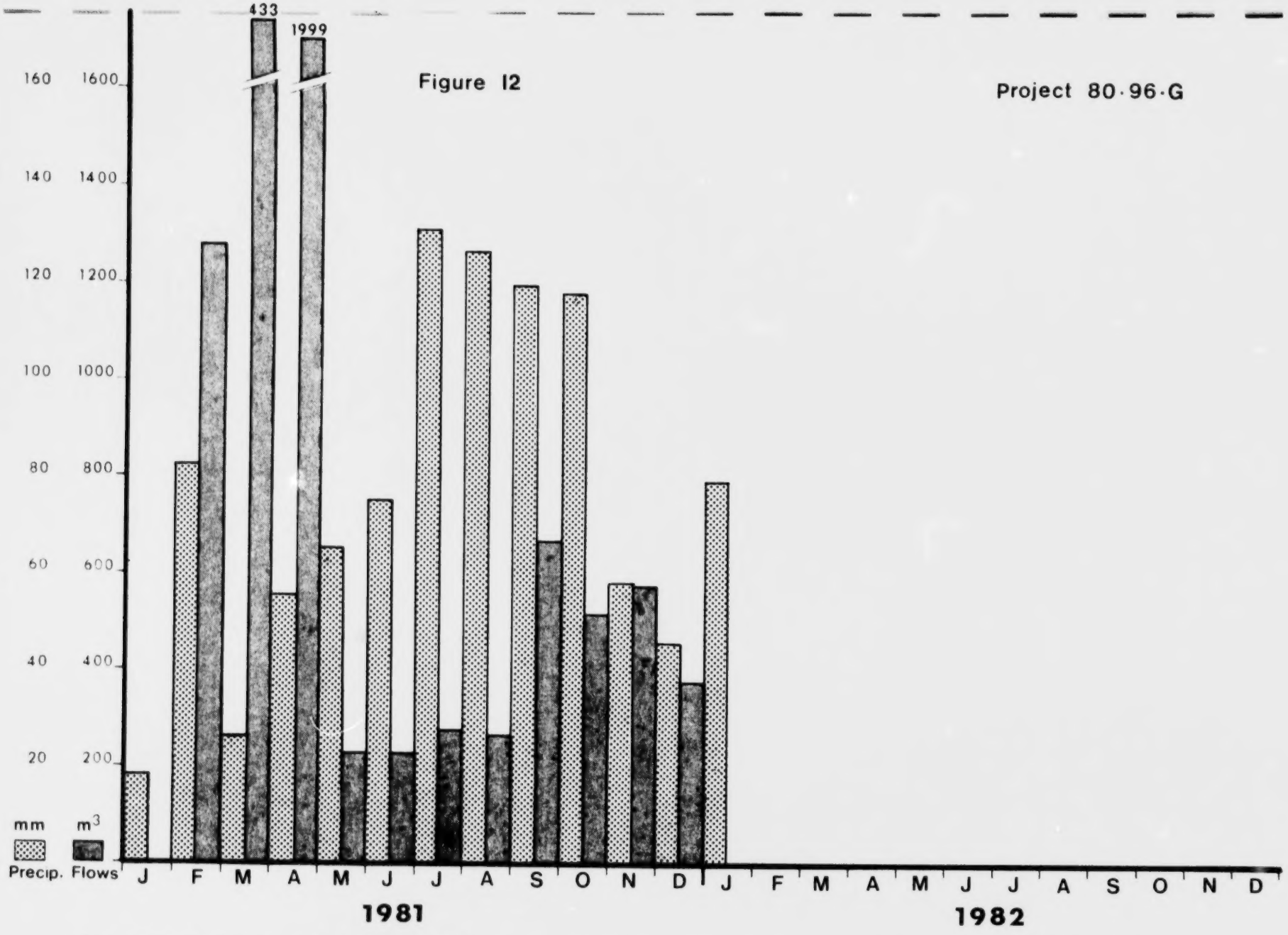
Figure 12 shows monthly precipitation and leachate pumpage data. Note that during February, March and April 1981 leachate pumpages were very large. This may be partially due to spring recharge events. Fall recharge events, however, do not appear to cause such large pumpages. It appears that the large flows in February, March and April are due to a dewatering effect which occurred when the system first started operation. This dewatering is probably localized around the toe-drain since no significant water level drops were observed in any of the ground water monitors.

Based on data collected between May and December 1981 (Figure 12) we anticipate that in 1982 monthly leachate

pumpages will range from about 200 m^3 to 800 m^3. We expect average flows will be about 500 m^3/month which equates to 6,000 m^3/year which is very near the calculated leachate production rate of 5,694 m^3/year.

Figure 12

Project 80·96·G



Georgetown Landfill Site – Precipitation (mm) And Flows From Leachate Collection System (m^3)

APPENDIX I

Borehole Logs

LIST OF ABBREVIATIONS

PENETRATION RESISTANCE

Standard Penetration Resistance 'N' - The number of blows required to advance a standard split spoon sampler 30 cm into the subsoil, driven by means of a 63.5 kg hammer falling freely a distance of 75 cm.

Dynamic Penetration Resistance - The number of blows required to advance a 5 cm, 60 degree cone, fitted to the end of drill rods, 30 cm into the subsoil, the driving energy being 475 J per blow.

DESCRIPTION OF SOIL

The consistency of cohesive soils and the relative density or denseness of cohesionless soils are described as follows:

Consistency	'N' Blows / .3 m	Denseness	'N' Blows / .3 m
Very Soft	0-2	Very Loose	0-4
Soft	2-4	Loose	4-10
Firm	4-8	Compact	10-30
Stiff	8-15	Dense	30-50
Very Stiff	15-30	Very Dense	> 50
Hard	> 30		

W.T.P.L. - Wetter than Plastic Limit
D.T.P.L. - Drier than Plastic Limit
A.P.L. - About Plastic Limit

DESCRIPTION OF ROCK

$$\% \text{ Recovery} = \frac{\text{Total Length of Core Recovered/Run}}{\text{Total Length of Drilling Run}} \times 100$$

TYPE OF SAMPLE

SS	-	Split Spoon
AS	-	Auger Sample
ST	-	Shelby Tube Sample
NX	-	Rock Core 56 mm ø

SYMBOLS

▲	-	Water Table Monitor (Standpipe Tip)
●	-	Piezometer Tip

BOREHOLE NO. 1

PROJECT NAME HALTON MONITORING — **PROJECT NO.** 80-96-G

CLIENT REGIONAL MUNICIPALITY OF HALTON — **DATE** Sept. 30, 1980

BOREHOLE TYPE CME 75, 0.11 m I.D. AUGERS — **GEOLOGIST** A.B.

ELEVATION (Ground) 252.8 m — **TECHNOLOGIST**

DEPTH m	STRATIGRAPHY	DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOW/0.3 m	SAMPLE % WATER	GROUND WATER	REMARKS
0.0		GARBAGE: Alternate layers of garbage and earth fill, moist - saturated at 9.14 m						- borehole is gravel backfilled from 7.62 m to 0.61 m
			1	SS	44			
		SAND: Medium brown silty fine sand, saturated					▲	- garbage caved at 7.62 m
12.8								- standpipe slotted from 10.67 m to 0.61 m
13.4			2	SS	120			
13.7		SAND AND GRAVEL: Coarse sandy fine gravel, saturated						
14.3		SHALE-TILL COMPLEX: Red brown shale till, hard, saturated						
		SHALE: Red brown shale with green layers					●	
18.9		Borehole terminated at 18.9 m in shale	3	SS	98			

● Piezometer Tip ▲ Standpipe Tip

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BOREHOLE NO. 2

PROJECT NAME: HALTON MONITORING
PROJECT NO.: 80-96-G
CLIENT: REGIONAL MUNICIPALITY OF HALTON
DATE: Oct. 1, 2, 1980
BOREHOLE TYPE: CME 75, 0.11 m I.D. AUGERS, 0.08 m TRICONE
GEOLOGIST: A.B.
ELEVATION: (Ground) 256.4 m
TECHNOLOGIST:

DEPTH m	STRATIGRAPHY	DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOW/0.3 m	SAMPLE % WATER	GROUND WATER	REMARKS
0.0		GARBAGE: Alternate layers of garbage and earth fill, moist - saturated at 8.8 m						- borehole is gravel backfilled from 10.67 m to 0.61 m - standpipe is slotted from 10.67 m to 0.61m
		SAND: Grey brown silty fine sand mixed with garbage, saturated					▲	
13.1								
14.0		SHALE-TILL COMPLEX: Red brown shale till, hard, saturated	1	SS	62		●	
15.5		SHALE Red brown shale with green layers						
20.4		Borehole terminated at 20.4 m in shale						

● Piezometer Tip ▲ Standpipe Tip

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BOREHOLE NO. 3

PROJECT NAME HALTON MONITORING — PROJECT NO. 80-96-G

CLIENT REGIONAL MUNICIPALITY OF HALTON — DATE Oct. 1, 1980

BOREHOLE TYPE CME 75, 0.11 m I.D. AUGERS, 0.08 m TRICONE — GEOLOGIST A.B.

ELEVATION (Ground) 256.1 m — TECHNOLOGIST

DEPTH m	STRATIGRAPHY	DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOW/0.3 m	SAMPLE % WATER	GROUND WATER	REMARKS
0.0		GARBAGE: Alternate layers of garbage and earth fill, -saturated at 11.89 m					▲	- borehole is gravel backfilled from 10.52 m to 0.61 m - standpipe slotted 10.52 m to 0.61 m
		SILT AND SAND: Alternate layers of medium brown silt and fine sand, saturated, compact						
15.1			1	SS	23			
16.8			2	AS				
18.1		SHALE-TILL COMPLEX: Red brown shale till, saturated, hard	3	SS	108			
		SHALE: Red brown shale with green layers						
24.4							●	
		Borehole terminated at 24.4 m in shale						

● Piezometer Tip ▲ Standpipe Tip

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BOREHOLE NO. 4

PROJECT NAME HALTON MONITORING — PROJECT NO. 80-96-G

CLIENT REGIONAL MUNICIPALITY OF HALTON — DATE Oct. 6, 1980

BOREHOLE TYPE CME 75, 0.11 m I.D. AUGERS, 0.08 m TRICONE — GEOLOGIST A.B.

ELEVATION (Ground) 220.5 m — TECHNOLOGIST

DEPTH m	STRATIGRAPHY	DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOW/0.3 m	SAMPLE % WATER	GROUND WATER	REMARKS
0.2		TOPSOIL						
		CLAYEY SILT: Red-brown clayey silt, odd stone, D.T.P.L. Saturated at 3.05 m						- borehole is gravel backfilled from 4.27 m to 0.61 m
3.4								
4.1		GRAVEL AND SAND: Grey gravelly medium sand, saturated					▲	- standpipe is slotted from 4.27 m to 0.61 m
		SHALE: Red brown shale with green layers						
11.9		Borehole terminated at 11.9 m in shale					●	

● Piezometer Tip ▲ Standpipe Tip

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BOREHOLE NO. 5

PROJECT NAME HALTON MONITORING — PROJECT NO. 80-96-G

CLIENT REGIONAL MUNICIPALITY OF HALTON — DATE Oct. 2, 3, 5, 1980

BOREHOLE TYPE CME 75, 0.11 m I.D. AUGERS, 0.08 m TIRCONE — GEOLOGIST A.B.

ELEVATION 5-1 (Ground) 219.0 m 5-2 (Ground) 219.3 m — TECHNOLOGIST

DEPTH m	STRATIGRAPHY	DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOW/0.3 m	SAMPLE % WATER	GROUND WATER	REMARKS
0.2		TOPSOIL						
1.5		CLAYEY SILT: Red brown clayey silt, odd stone, A.P.L.						Borehole is gravel backfilled from 10.4 m to 0.61 m
3.7		SAND AND GRAVEL: Medium brown sand and gravel, saturated, odd boulder					▲	Standpipe slotted from 10.4 m to 0.61 m
		SHALE: Red brown shale with green layers					●	
10.4		Borehole terminated at 10.4 m in shale						

● Piezometer Tip ▲ Standpipe Tip

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BOREHOLE NO. 6

PROJECT NAME HALTON MONITORING — **PROJECT NO.** 80-96-G

CLIENT REGIONAL MUNICIPALITY OF HALTON — **DATE** Oct. 6, 1980

BOREHOLE TYPE CME 75, 0.11 m I.D. AUGERS, 0.08 m TRICONE — **GEOLOGIST** A.B.

ELEVATION (Ground) 241.2 m — **TECHNOLOGIST**

DEPTH m	STRATIGRAPHY	DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOW/0.3 m	SAMPLE % WATER	GROUND WATER	REMARKS
0.0		FILL: Red brown clayey silt fill with stones						- borehole backfilled with gravel from 11.28 m to 0.61 m - standpipe slotted from 11.28 m to 0.61 m
3.0		SHALE: Red brown shale with green layers - water at 6.7 m					▲	
23.8		Borehole terminated at 23.8 m in shale.					●	

● Piezometer Tip ▲ Standpipe Tip

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BOREHOLE NO. GM 1

PROJECT NAME METHANE MIGRATION STUDY (GEORGETOWN) LANDFILL — PROJECT NO. 80-96-G

CLIENT REGIONAL MUNICIPALITY OF HALTON — DATE Feb. 12, 1979

BOREHOLE TYPE 0.02 m I.D. HOLLOW STEM AUGERS — GEOLOGIST E.G.A.

ELEVATION (Ground) 258.0 m — TECHNOLOGIST L.L.

DEPTH m	STRATIGRAPHY	DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOW/0.3 m	SAMPLE % WATER	GROUND WATER	REMARKS
0.0		COVER MATERIAL: Dark brown clayey silt, moist						
3.1			1	SS	10	14		
3.4		TOPSOIL						
		TILL: Medium grey brown clayey silt till with grey clay lenses 0.3 cm thick, wet, saturated from 6.7 m, difficult augering from 8.5 m	2	SS	11	25		Gas monitor is slotted from 4.88 m to 10.67 m below the ground surface.
			3	SS	20	23		
9.5			4	SS	20	22		
			5	SS	39	8		
11.0		SAND Red brown silty fine sand, grading to fine sand with depth, saturated	6	SS	86	17	▲	
		Borehole terminated at 11.1 m in fine sand. On completion borehole caved at 10.1 m and water level was at 7.0 m						

● Piezometer Tip ▲ Standpipe Tip

Gartner Lee Associates Limited

BOREHOLE NO. GM 2

PROJECT NAME METHANE MIGRATION STUDY (GEORGETOWN) LANDFILL — PROJECT NO. 80-96-G

CLIENT REGIONAL MUNICIPALITY OF HALTON — DATE Feb. 12, 1979

BOREHOLE TYPE 0.02 m I.D. HOLLOW STEM AUGERS — GEOLOGIST E.G.A.

ELEVATION (Ground) 256.3 m — TECHNOLOGIST L.L.

DEPTH m	STRATIGRAPHY	DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOW/0.3 m	SAMPLE % WATER	GROUND WATER	REMARKS
0.0		TILL: Medium brown clayey silt till; moist; saturated at 3.4 m fine sand seams at 5.8 m -turning grey at 6.4 m	1	SS	12	24		Gas monitor is slotted from 1.52 m to 7.0 m below the ground surface
			2	SS	13	19		
			3	SS	10	24		
			4	SS	16	26	▲	
8.1			5	SS	18	23		
		Borehole terminated at 8.1 m in grey clayey silt till. On completion borehole was open and water level was at ±6.7 m						

● Piezometer Tip ▲ Standpipe Tip

Gartner Lee Associates Limited

BOREHOLE NO. GM 3

PROJECT NAME METHANE MIGRATION STUDY (GEORGETOWN) LANDFILL — PROJECT NO. 80-96-G

CLIENT REGIONAL MUNICIPALITY OF HALTON — DATE Feb. 12, 1980

BOREHOLE TYPE 0.02 m I.D. HOLLOW STEM AUGERS — GEOLOGIST E.G.A.

ELEVATION (Ground) 253.9 m — TECHNOLOGIST L.L.

DEPTH m	STRATIGRAPHY	DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOW/0.3 m	SAMPLE % WATER	GROUND WATER	REMARKS
0.0								
2.1		FILL MATERIAL: Medium brown silt intermittent small grey clay nodules, moist	1	SS	50/0.1	15		Gas monitor is slotted from 2.44 m to 8.10 m below the ground surface
5.4		GLACIAL TILL: Medium brown clayey silt till, moist, becoming saturated at 4.4 m and turning yellow brown to red brown	2	SS	94	13		
			3	SS	114	9		
7.8		FINE SAND: Medium brown fine sand, saturated	4	SS	65	21		
8.1		SILTY CLAY: Medium to dark grey, silty clay, saturated.	5	SS	64	20	▲	
		Borehole terminated at 8.1 m in silty clay. On completion borehole was open and water level was at 6.1 m.						

● Piezometer Tip ▲ Standpipe Tip

Gartner Lee Associates Limited

BOREHOLE NO. GM 4

PROJECT NAME HALTON MONITORING — PROJECT NO. 80-96-G

CLIENT REGIONAL MUNICIPALITY OF HALTON — DATE Sept. 30, 1980

BOREHOLE TYPE CME 75, 0.11 m I.D. AUGERS — GEOLOGIST A.B.

ELEVATION (Ground) 251.8 m — TECHNOLOGIST

DEPTH m	STRATIGRAPHY	DESCRIPTION	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOW/0.3 m	SAMPLE % WATER	GROUND WATER	REMARKS
0.0		GARBAGE: Alternate layers of garbage and earth fill, saturated at 6.71 m					▲	- Borehole backfilled with gravel from 7.01 m to 0.61 m - Standpipe slotted from 7.01 m to 0.61 m
7.5		Borehole terminated at 7.50 m in garbage.						

● Piezometer Tip ▲ Standpipe Tip

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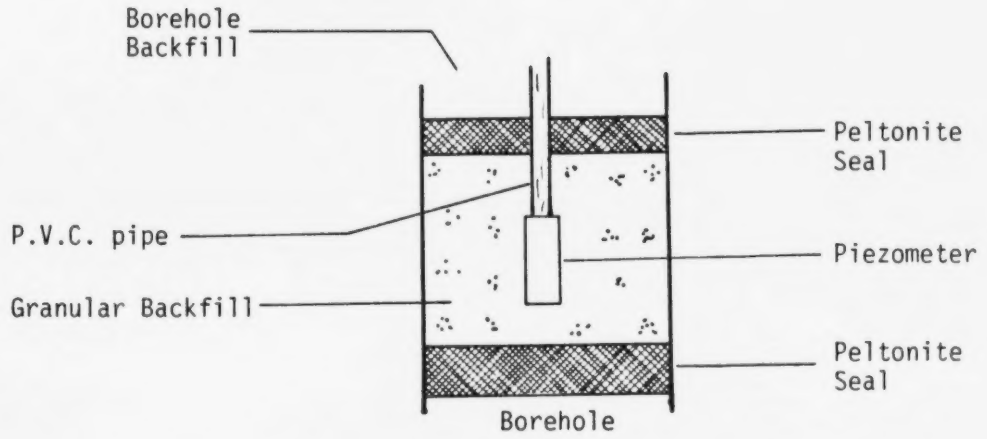
Monitor Details

GROUND WATER MONITOR DETAILS

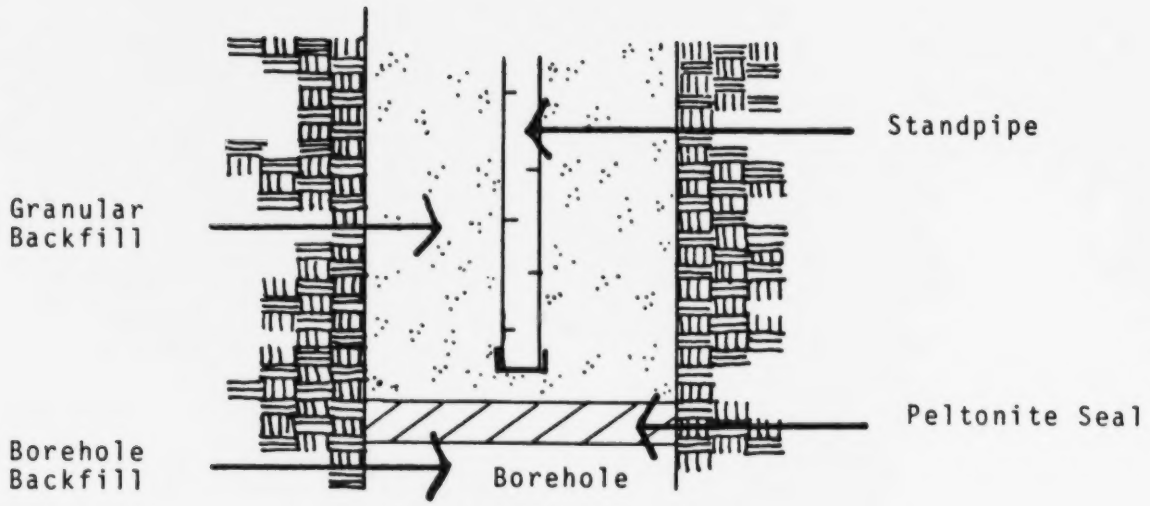
INSTALLATION DETAILS

A. PIEZOMETER: The piezometers consist of PVC pipe slotted and wrapped with fiberglass cloth over .5 m . Piezometers are used to measure the hydrostatic pressure, to obtain ground water samples and to measure in situ permeability.



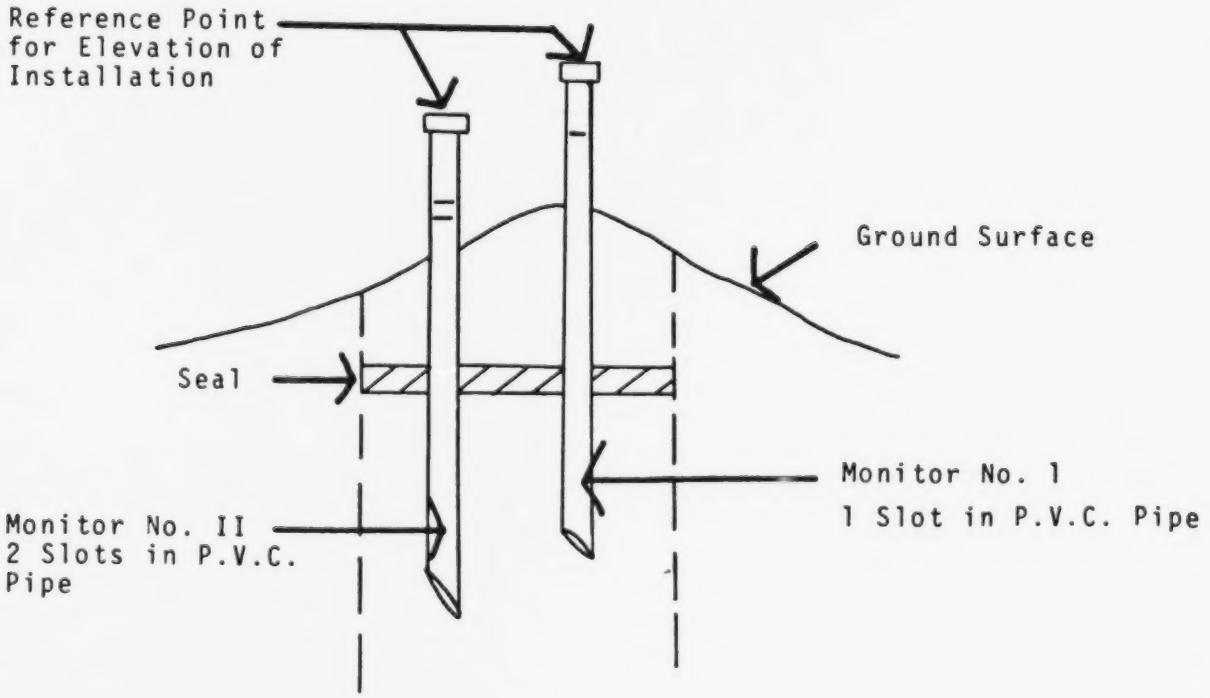
TYPICAL INSTALLATION

B. STANDPIPE: Standpipes consist of P.V.C. pipe slotted from the bottom to 0.61 m below the surface. Slots are every 0.1 m and wrapped in fiberglass cloth. Standpipes are used to measure the ground water table and to obtain ground water samples.



TYPICAL INSTALLATION

SURFACE DETAILS



C. GAS MONITOR: Gas monitors consist of PVC pipe slotted every 0.1 m from the bottom of the monitor to 0.61 m below the surface. All slots are wrapped in fiberglass cloth to prevent siltation. The borehole is backfilled with gravel to 0.61 m below ground surface and cement is put on the gravel to act as a seal.

PROJECT 80-96-G

TABLE 3 SHEET 1

GROUND WATER MONITOR DETAILS *

BOREHOLE NO.	MONITOR				LOCATION OF TIP		LOCATION OF SEAL	
	No.	Diameter (mm)	Type	Elev.	Depth	Elev.	Depth	Elev.
1	I	31	●	253.45	18.90	234.55	17.98	235.47
	II	31	▲	253.45	11.28	242.17	11.28 1.22	242.17 252.23
2	I	31	●	257.05	17.13	239.92	16.46	240.59
	II	31	▲	257.02	11.28	245.74	11.28 1.22	245.74 255.8
3	I	31	●	256.84	25.15	231.69	23.32	233.52
	II	31	▲	256.81	11.28	245.53	19.87 1.37	236.94 255.44
4	I	31	●	221.39	11.28	210.11	9.45	211.94
	II	31	▲	221.39	5.18	216.21	5.33 1.52	216.06 219.87
5	I	31	●	220.25	6.10	214.15	10.36	209.89
	II	31	▲	220.55	11.28	209.27	1.83	218.72
6	I	31	●	241.70	24.84	217.41	23.32	218.93
	II	31	▲	242.08	12.19	229.89	12.19 1.52	229.89 240.56
GM 1	I	19	▲	258.54	10.67	247.87	3.04 - 3.35 cement seal	255.5-255.19
GM 2	I	19	▲	256.57	7.01	249.56	1.22 - 1.52 cement seal	255.35-255.05
GM 3	I	19	▲	253.86	8.08	245.78	0.91 - 1.52 cement seal	252.95-252.34
GM 4	I	31	▲	252.19	7.47	244.72	0.46 - 1.07 cement seal	251.73-251.12

* Reference point for each monitor is the top of the individual pipe.

● - Piezometer ▲ - Standpipe

Ground Water Elevations

PROJECT 80-96-G

TABLE 4 SHEET 1

GROUND WATER ELEVATIONS

BOREHOLE NUMBER	MONITOR		Oct. 14 1980	Oct. 27 1980	Nov. 18 1980	Dec. 4 1980	Jan. 12 1981	Mar. 24 1981	Apr.7 1981	May 22 1981	Oct.13 1981	Nov.18 1981	Dec.14 1981
	No.	Type											
BH 1	I	●	241.73	241.84	241.80	241.55	241.68	241.59	241.57	241.82	242.36	242.72	242.66
	II	▲	247.89	247.42	247.42	247.45	247.77	Blocked	247.55	248.11	248.94	248.13	247.96
BH 2	I	●	247.57	247.63	247.70	247.54	247.60	247.50	247.47	247.52	247.54	247.77	247.69
	II	▲	248.52	248.61	248.76	248.10	248.20	248.18	248.15	248.36	248.39	248.68	248.59
BH 3	I	●	243.52	240.29	242.19	241.79	242.66	242.93	242.93	241.85	239.59	239.64	239.72
	II	▲	246.69	246.61	246.70	246.61	246.72	<245.5 dry	246.66	246.56	246.79	246.85	246.86
BH 4	I	●	217.07	217.19	217.08	217.39	217.48	217.08	217.14	217.05	217.05	217.19	217.08
	II	▲	217.32	217.43	217.25	217.60	217.63	217.24	217.29	217.17	217.23	217.30	217.25
BH 5	I	●	216.71	216.86	216.77	216.98	217.10	216.79	216.84	216.76	216.74	216.86	217.11
	II	▲	217.00	217.24	217.18	217.44	217.46	217.06	217.08	217.02	216.85	217.19	218.20
									Piez repaired new elevation 241.70				
BH 6	I	●	227.24	226.92	227.48	227.50	227 55	227.51	227.61	227.56	227.52	224.61	227.30
	II	▲	234.95	236.77	235.48	235.97	235.63	236.19	236.11	236.12	236.2	235.93	235.94
GM 1		▲					249.31	249.17	249.34	249.18	249.24	249.20	249.35
GM 2		▲						254.02	254.04	254.08	254.69	255.14	253.99
GM 3		▲						250.48	250.43	250.53	250.86	251.14	250.41
GM 4		▲		248.04		247.95	247.9	247.81	247.89	248.13	248.33	248.47	248.53

● – Piezometer ▲ – Standpipe

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PROJECT 80-96-G

TABLE 4 SHEET 2

GROUND WATER ELEVATIONS

BOREHOLE NUMBER	MONITOR		Jan.21 1982	Feb.17 1982	Mar.22, 1982	Apr.8, 1982								
	No.	Type												
BH 1	I		242.67	242.34	242.45	242.57								
	II		248.01	Frozen	Frozen	248.45								
BH 2	I		247.75	247.58	247.64	247.59								
	II		248.97	248.62	248.68	248.66								
BH 3	I		239.73	239.84	239.86	239.99								
	II		246.83	246.81	246.58	246.81								
BH 4	I		217.06	217.39	217.75	217.40								
	II		217.19	217.61	218.02	217.73								
BH 5	I		217.05	219.37	Blocked	-								
	II		-	-	Destroyed	-								
BH 6	I		227.22	225.3	226.98	227.12								
	II		235.56	235.38	235.40	235.44								
GM 1			249.34	249.34	249.24	249.26								
GM 2			253.97	254.04	254.15	254.02								
GM 3			250.45	Frozen	Frozen	250.82								
GM 4			248.50	248.01	247.99	248.47								

● - Piezometer ▲ - Standpipe

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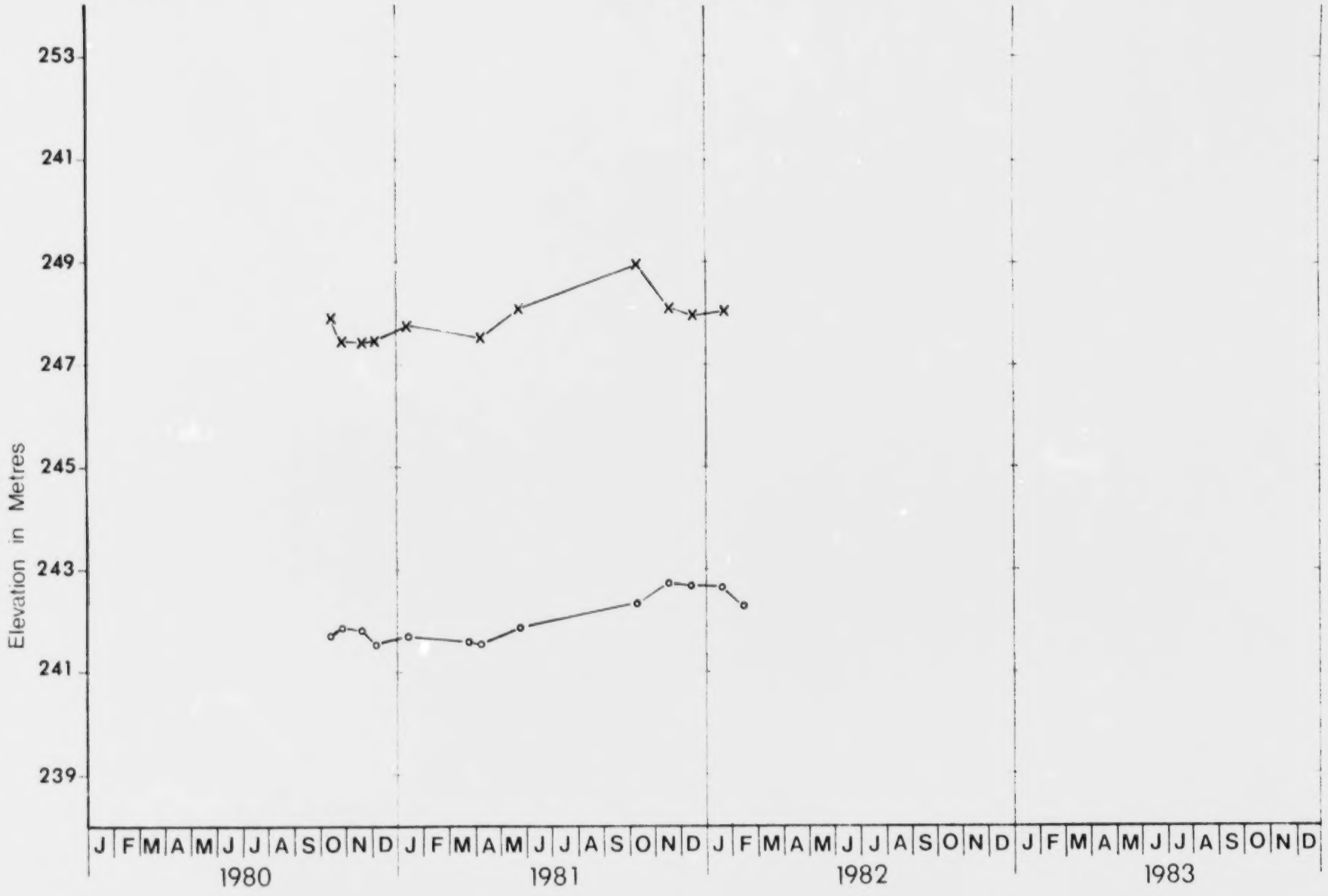
HYDROGRAPHS

FIGURE 4

Hydrograph

Project 80-96

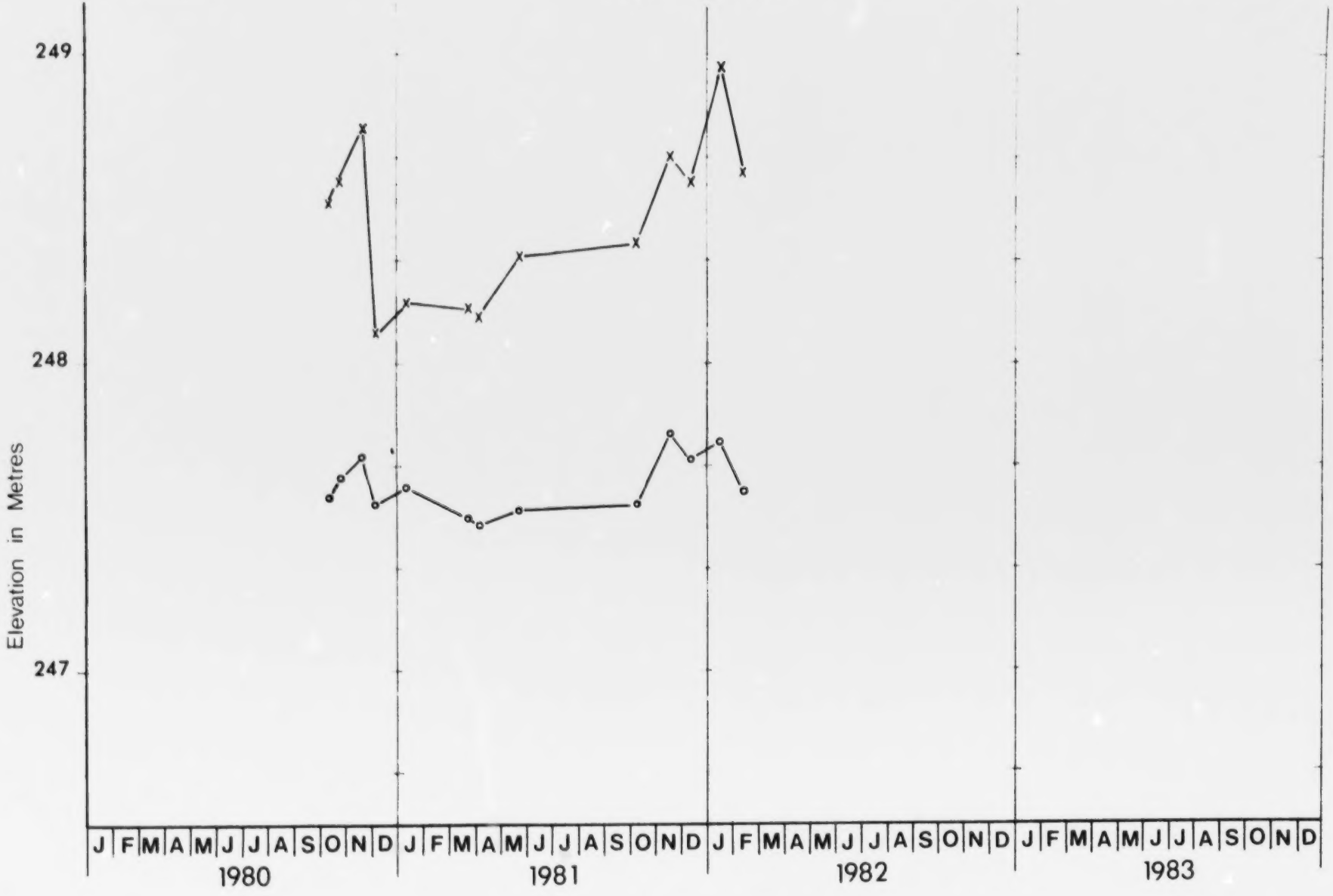

253
241
249
247
245
243
241
239
Elevation in Metres
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1980
1981
1982
1983

HALTON HILLS LANDFILL : Borehole 1 . Monitors I ∘—∘ . II x—x

FIGURE 5

Hydrograph

Project 80-96

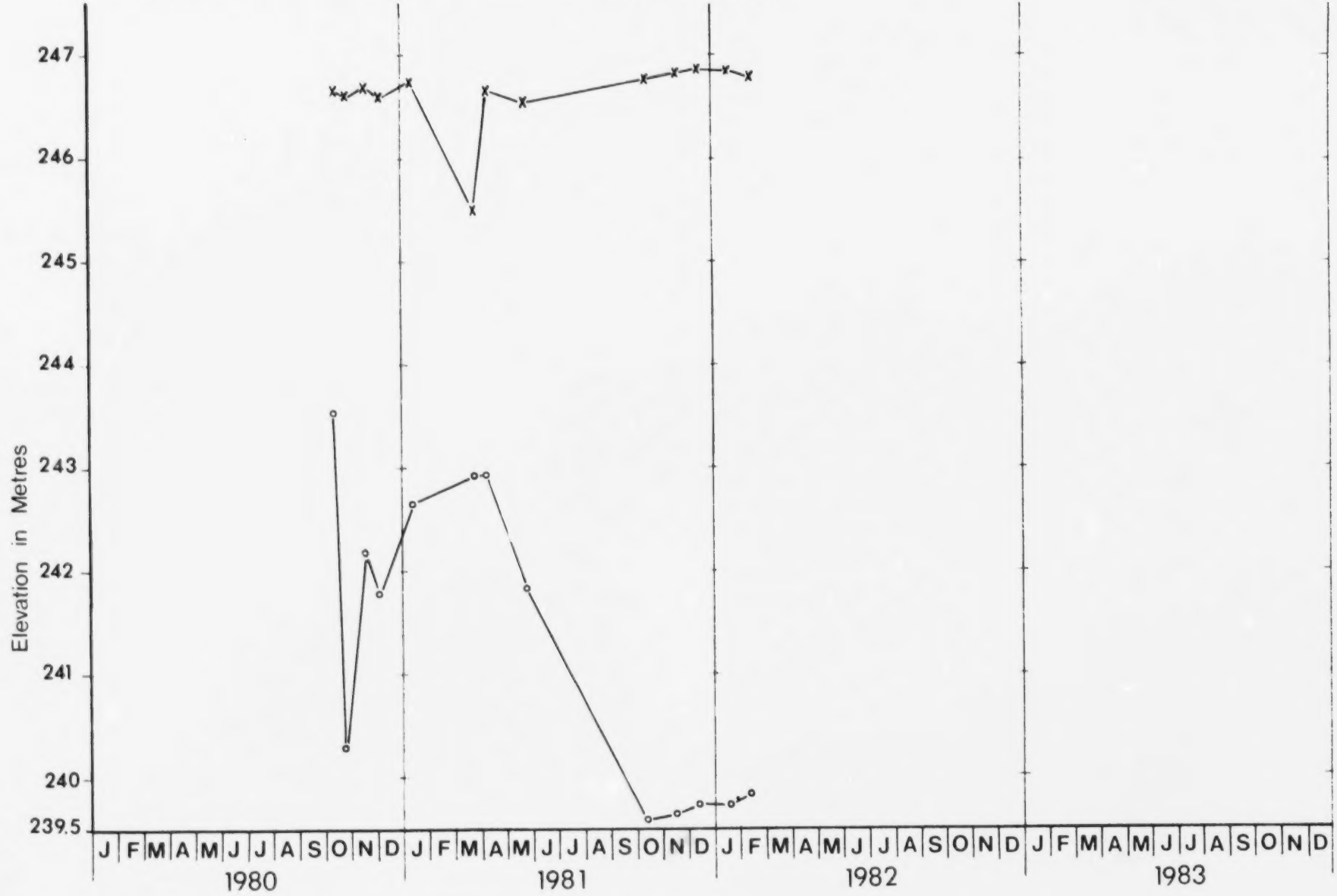


HALTON HILLS LANDFILL : Borehole 2 , Monitors I o—o , II x—x

FIGURE 6

Hydrograph

Project 80-96

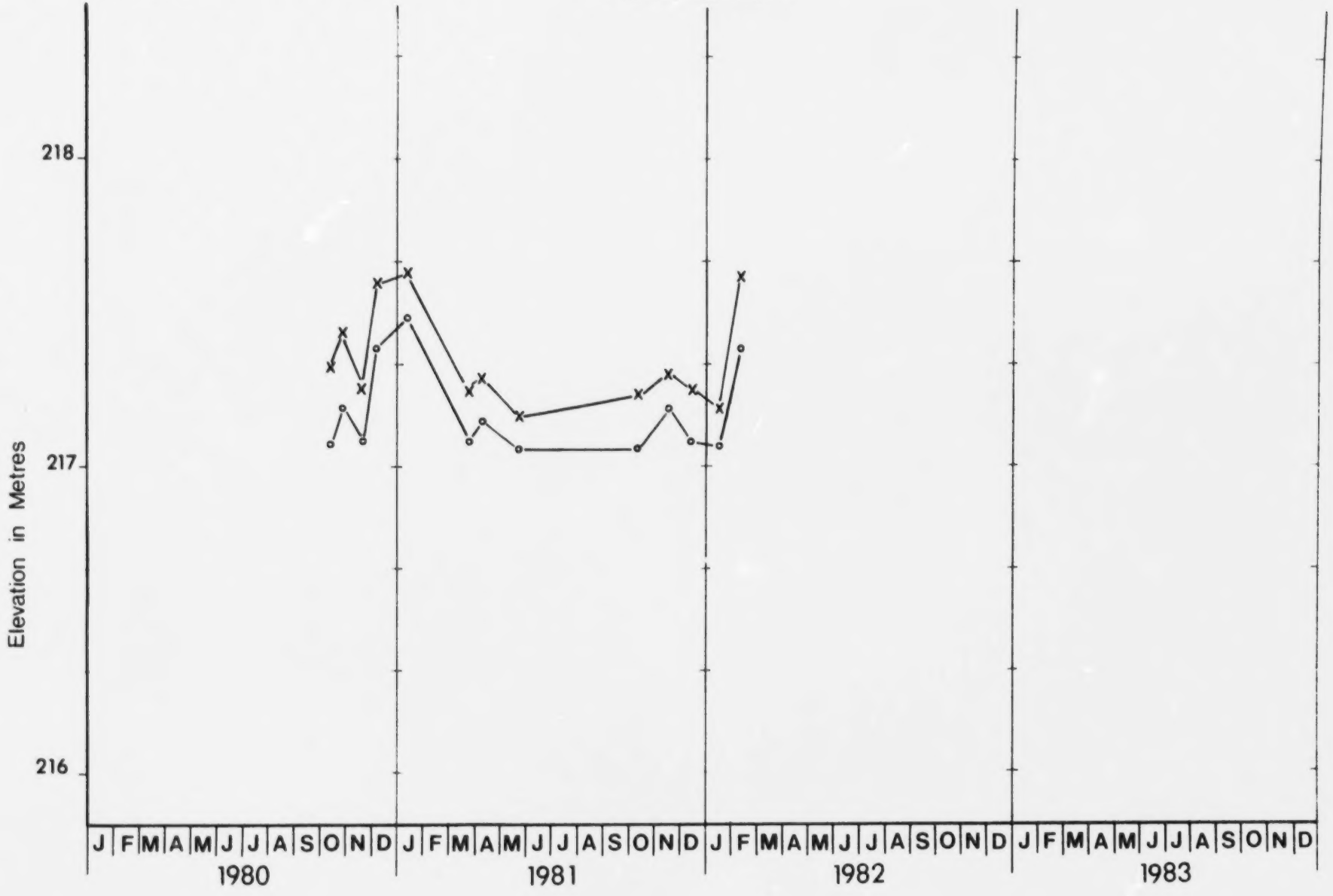

247
246
245
244
243
242
241
240
239.5
Elevation in Metres
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1980
1981
1982
1983

HALTON HILLS LANDFILL : Borehole 3 . Monitors I ∘—∘ . II x—x

FIGURE 7

Hydrograph

Project 80·96

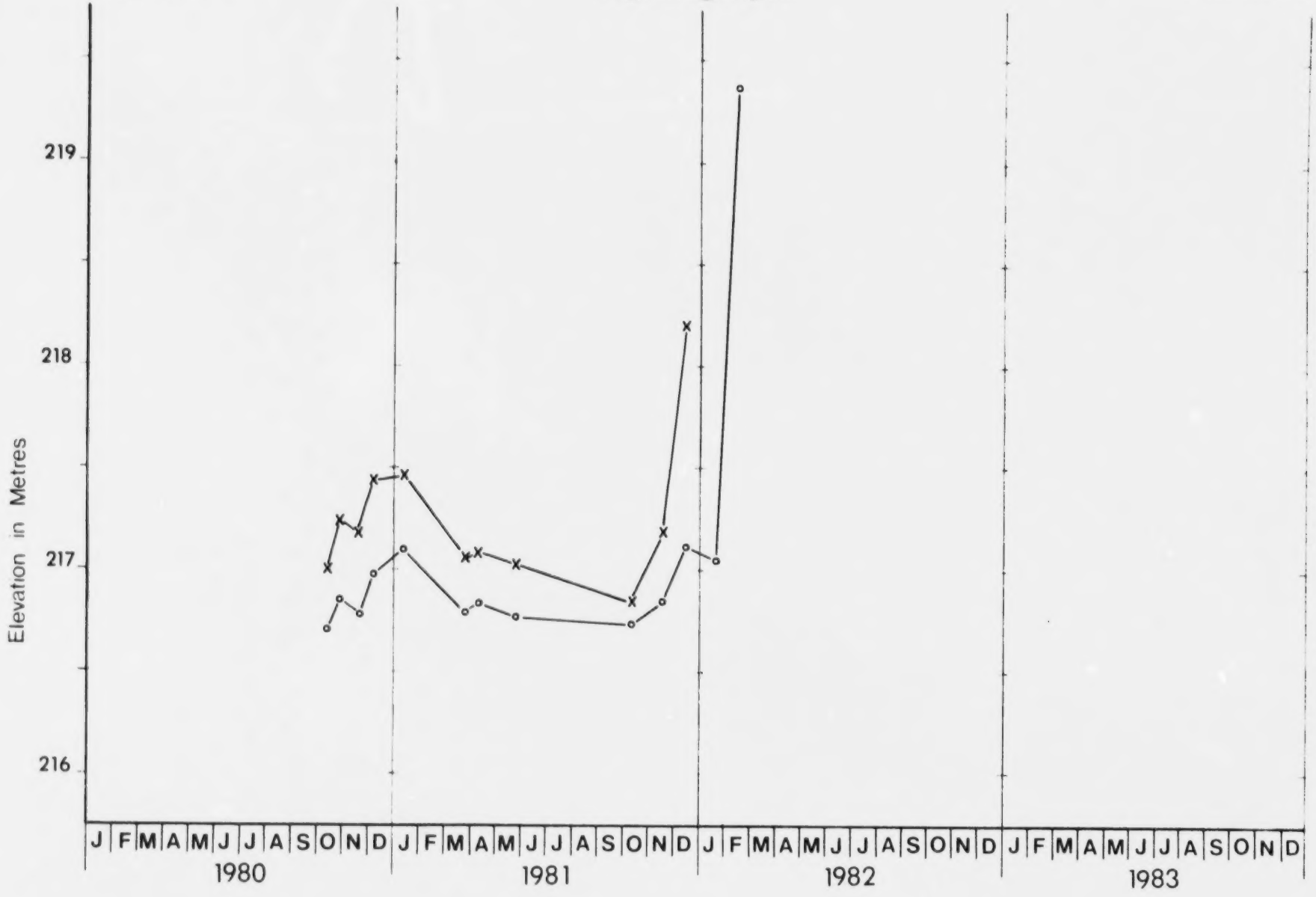


HALTON HILLS LANDFILL : Borehole 4 , Monitors I ∘——∘ ,II x——x

FIGURE 8

Hydrograph

Project 80 96

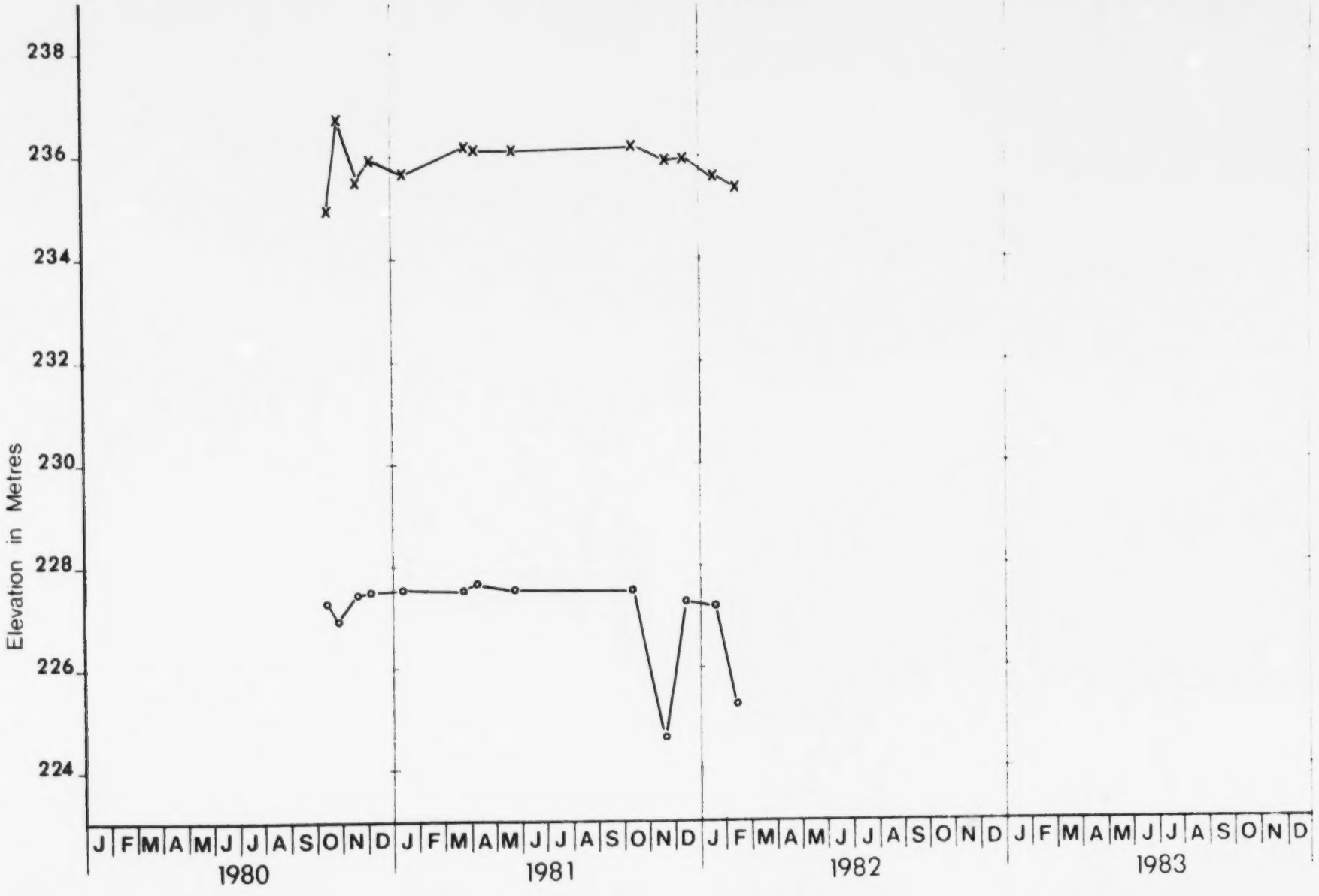


HALTON HILLS LANDFILL : Borehole 5 , Monitors I o—o , II x—x

FIGURE 9

Hydrograph

Project 80 96


238
236
234
232
230
228
226
224
Elevation in Metres
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1980
1981
1982
1983

HALTON HILLS LANDFILL : Borehole 6 . Monitors I o—o . II x—x

APPENDIX II

Ground Water Chemical Analysis Results

Ontario Ministry of the Environment

Drinking Water Quality Criteria

for the Substances Analyzed

Substance	Concentration
Chloride (Cl)	250.0
Sulphate (SO_4)	250.0
Organic Nitrogen (Total Kjeldahl minus free ammonia)	0.15
Nitrate (N)	10.0
Iron (Fe)	0.3
Phenols	0.001

PROJECT 80-96-G

TABLE 5 SHEET 1

WATER ANALYSIS RESULTS

LOCATION HALTON HILLS LANDFILL

REMARKS BH-1 Piezometer 1

PROPERTY		Oct. 1980	Dec. 1980	Jan. 1981	Apr.7 1981	May 22 1981	Oct.14 1981	Nov.20 1981				
CONDUCTIVITY μMHOS/CM.		1825	1510	1550	1450	1355	1180	1110				
pH		7.0	7.4	6.9			7.3	7.3				
HARDNESS ($CaCO_3$)		-	755	-	640	580	510	509				
ALKALINITY ($CaCO_3$)			747	-			465	414				
CHLORIDES (Cl)		170	149	139	139	100	102	100				
SULPHATES (SO_4)		182	91	55	48	71	87	99				
PHOSPHOROUS AS P	Total				.06		.18	.30				
	Soluble				<.02							
NITROGEN (N)	Total Kjeldahl	5.2	3.0	1.4	.6	3.6	1.6	1.0				
	Free Ammonia	3.0	.2	.2	.2	0.3	.5	.1				
	Nitrite	.02	.01	.01	.01	<.01	<.01	<.01				
	Nitrate	<.1	<.1	<.1	<.1	<.1	<.1	<.1				
METALS	Potassium (K)	-	.7	-			10	7.7				
	Magnesium (Mg)	-	60	-			39	40				
	Calcium (Ca)	-	204	-			140	138				
	Sodium (Na)	-	56	-			71	66				
	Iron (Fe)	13	41	11	4.4	13	2.5	4.1				
BOD		350	160	125	32	48	32	13				
COD		700	330	240	134	86	60	35				
Phenol (ppb)		-	300	-	162	5	-	-				

NOTE: concentrations in p.p.m. unless otherwise noted.

Gartner Lee Associates Limited

PROJECT 80-96-G

TABLE 5 SHEET 2

WATER ANALYSIS RESULTS

LOCATION HALTON HILLS LANDFILL

REMARKS BH-1 Standpipe 11

PROPERTY		Oct. 1980	Dec. 1980	Jan. 1981	Apr.7 1981	May 22 1981	Oct.14 1981	Nov.20 1981				
CONDUCTIVITY μMHOS/CM.		2050	2600	3600	1800	1520	1460	2450				
pH		6.8	7.1	6.7			6.9	6.9				
HARDNESS ($CaCO_3$)			860	-	635	568	560	863				
ALKALINITY ($CaCO_3$)			1160	-			756	1293				
CHLORIDES (Cl)		216	142	311	194	136	115	208				
SULPHATES (SO_4)		61	14	60	20	56	21	14				
PHOSPHOROUS AS P	Total				1.4		1.70	1.10				
	Soluble				<.02							
NITROGEN (N)	Total Kjeldahl	27	63	245	51	17	41	83				
	Free Ammonia	21	46	155	22	13	26	80				
	Nitrite	.18	.03	.02	.03	.02	<.01	.04				
	Nitrate	.1	<.1	.1	<.1	<.1	<.1	1				
METALS	Potassium (K)		19				21.3	78				
	Magnesium (Mg)		68				41	76				
	Calcium (Ca)		232				156	220				
	Sodium (Na)		85				94	198				
	Iron (Fe)	64	147	50	590	40	208	94				
BOD		170	310	800	245	48	300	340				
COD		300	720	1500	1015	86	620	860				
Phenol (ppb)			500		166	3						

NOTE: concentrations in p.p.m. unless otherwise noted.

Gartner Lee Associates Limited

PROJECT 80-96-G

TABLE 5 SHEET 3

WATER ANALYSIS RESULTS

LOCATION HALTON HILLS LANDFILL

REMARKS BH-2 Piezometer 1

PROPERTY		Oct. 1980	Dec. 1980	Jan. 1981	Apr.7 1981	May 22 1981	Oct.14 1981	Nov.20 1981				
CONDUCTIVITY μMHOS/CM.		3800	1175	1460	1160	1130	1510	1090				
pH		6.8	7.2	6.9			7.0	7.2				
HARDNESS ($CaCO_3$)			624		610	572	680	680				
ALKALINITY ($CaCO_3$)			638				835	666				
CHLORIDES (Cl)		327	42	31	38	35	93	38				
SULPHATES (SO_4)		17	8	4	11	17	22	12				
PHOSPHOROUS AS P	Total				.04		1.00	.26				
	Soluble				<.02							
NITROGEN (N)	Total Kjeldahl	112	8.0	2.0	1.9	2.5	18	1.6				
	Free Ammonia	97	3.8	1.0	.4	0.8	15	1.0				
	Nitrite	.04	.02	.01	.01	<.01	<.01	.01				
	Nitrate	.2	<.1	<.1	<.1	<.1	<.1	<.1				
METALS	Potassium (K)		9.4				19.1	4.4				
	Magnesium (Mg)		62				63	57				
	Calcium (Ca)		147				168	178				
	Sodium (Na)		28				57	17.5				
	Iron (Fe)	160	30	38	37	12.6	91	27				
BOD		2750	130	52	1.2	28	30	15				
COD		4100	320	180	33	34	140	55				
Phenol (ppb)			300		<1	<1						

NOTE: concentrations in p.p.m. unless otherwise noted.

Gartner Lee Associates Limited

PROJECT 89-96-G

TABLE 5 SHEET 4

WATER ANALYSIS RESULTS

LOCATION HALTON HILLS LANDFILL

REMARKS BH-2 Standpipe 11

PROPERTY		Oct. 1980	Dec. 1980	Jan. 1981	Apr.7 1981	May 22 1981	Oct.14 1981	Nov.20 1981				
CONDUCTIVITY μMHOS CM.		9500	8500	8000	8800	8100	6800	2725				
pH		6.7	6.9	6.8			7.0	6.7				
HARDNESS ($CaCO_3$)			2,466		1640	1660	1520	954				
ALKALINITY ($CaCO_3$)			3,520				3470	1418				
CHLORIDES (Cl)		1046	990	942	1000	899	780	243				
SULPHATES (SO_4)		60	33	40	24	24	22	14				
PHOSPHOROUS AS P	Total				4.7		5.3	.70				
	Soluble				.48							
NITROGEN (N)	Total Kjeldahl	420	350	410	380	385	290	85				
	Free Ammonia	355	330	290	325	300	260	85				
	Nitrite	.10	.10	.06	.26	.28	.07	.07				
	Nitrate	.3	.3	.2	.4	.1	.2	.1				
METALS	Potassium (K)		324				300	90				
	Magnesium (Mg)		235				226	79				
	Calcium (Ca)		600				236	252				
	Sodium (Na)		720				725	192				
	Iron (Fe)	530	188	210	110	149	119	144				
BOD		6200	3300	1800	370	340	210	190				
COD		11,000	6,000	3,800	2020	1400	1010	500				
Phenol (ppb)		-	7,500		710	110						

NOTE: concentrations in p.p.m. unless otherwise noted.

Gartner Lee Associates Limited

PROJECT 80-96-G

TABLE 5 SHEET 5

WATER ANALYSIS RESULTS

LOCATION HALTON HILLS LANDFILL

REMARKS BH-3 Piezometer 1

PROPERTY		Oct. 1980	Dec. 1980	Jan. 1981	Apr.7 1981	May 22 1981	Oct.14 1981	Nov.20 1981				
CONDUCTIVITY μMHOS/CM.		950	840	870	840	810	870	850				
pH		7.3	7.4	7.4			7.5	7.6				
HARDNESS ($CaCO_3$)			378		335	352	340	311				
ALKALINITY ($CaCO_3$)			271				331	294				
CHLORIDES (Cl)		57	17	10	16	14	24	25				
SULPHATES (SO_4)		108	205	185	160	140	140	155				
PHOSPHOROUS AS P	Total				.04		.46	.14				
	Soluble				.02							
NITROGEN (N)	Total Kjeldahl	9.0	2.0	3.2	6.0	5.0	8.2	3.4				
	Free Ammonia	1.6	1.0	2.6	1.6	2.0	3.5	2.5				
	Nitrite	<.01	.01	.01	.02	.02	.01	.01				
	Nitrate	<.1	.1	<.1	.1	.1	<.1	.1				
METALS	Potassium (K)		22.8				20.5	19.6				
	Magnesium (Mg)		26				28	17				
	Calcium (Ca)		109				90	96				
	Sodium (Na)		45				50	52				
	Iron (Fe)	15	3.3	1.9	2.96	8.5	19.6	1.06				
BOD		58	4.0	4.0	1.8	7.5	-	26				
COD		400	110	83	42	63	105	25				
Phenol (ppb)			1000		1	1						

NOTE: concentrations in p.p.m. unless otherwise noted.

Gartner Lee Associates Limited

PROJECT 80-96-G

TABLE 5 SHEET 6

WATER ANALYSIS RESULTS

LOCATION HALTON HILLS LANDFILL REMARKS BH-3 Standpipe 11

PROPERTY		Oct. 1980	Dec. 1980	Jan. 1981	Apr.7 1981	May 22 1981	Oct.14 1981	Nov.20 1981				
CONDUCTIVITY μMHOS CM		1850	1675	1550	2500	3060	3775	3025				
pH		6.6	6.8	6.4			6.8	6.8				
HARDNESS ($Ca CO_3$)			780		910	1010	1130	1051				
ALKALINITY ($Ca CO_3$)			928				1933	1450				
CHLORIDES (Cl)		122	113	97	220	270	375	337				
SULPHATES (SO_4)		6	12	10	9	8	11	13				
PHOSPHOROUS AS P	Total				4.3		2.5	.80				
	Soluble				<.02							
NITROGEN (N)	Total Kjeldahl	26	31	23	58	104	115	94				
	Free Ammonia	23	18	17	39	74	110	94				
	Nitrite	.01	.01	.01	.03	.06	.05	.06				
	Nitrate	<.1	<.1	<.1	.1	<.1	<.1	.1				
METALS	Potassium (K)		23.2				110	91				
	Magnesium (Mg)		53				122	97				
	Calcium (Ca)		224				252	260				
	Sodium (Na)		60				255	198				
	Iron (Fe)	110	88	126	222	143	159	92				
BOD		245	180	120	130	65	100	40				
COD		400	330	340	420	390	450	300				
Phenol (ppb)			1,000		97	54						

NOTE: concentrations in p.p.m. unless otherwise noted.

Gartner Lee Associates Limited

PROJECT 80-96-G

TABLE 5 SHEET 7

WATER ANALYSIS RESULTS

LOCATION HALTON HILLS LANDFILL

REMARKS BH-4 Piezometer 1

PROPERTY		Oct. 1980	Dec. 1980	Jan. 1981	Apr.7 1981	May 22 1981	Oct.14 1981	Nov.20 1981				
CONDUCTIVITY μMHOS CM		1925	2,000	2050	2150	2100	2225	2000				
pH		7.0	7.4	7.0			7.4	7.1				
HARDNESS ($CaCO_3$)			871		800	850	850	993				
ALKALINITY ($CaCO_3$)			307				429	678				
CHLORIDES (Cl)		263	408	375	405	380	412	279				
SULPHATES (SO_4)		102	285	285	275	280	290	195				
PHOSPHOROUS AS P	Total				.04		2.1	.06				
	Soluble				.02							
NITROGEN (N)	Total Kjeldahl	2.5	.6	.6	2.0	.8	4.6	3.4				
	Free Ammonia	0.8	<.1	<.1	2.0	.2	.6	.9				
	Nitrite	<.01	<.01	<.01	.01	.02	<.01	.01				
	Nitrate	<.1	<.1	<.1	.1	<.1	<.1	.1				
METALS	Potassium (K)		6.6				10	9				
	Magnesium (Mg)		75				70	81				
	Calcium (Ca)		226				224	264				
	Sodium (Na)		144				144	126				
	Iron (Fe)	18	2.0	1.6	.77	1.23	107	20.4				
BOD		2.	1.0	.6	0.8	4.0	9.0	10				
COD		79	85	27	30	31	175	50				
Phenol (ppb)			4		< 1	<1						

NOTE: concentrations in p.p.m. unless otherwise noted.

Gartner Lee Associates Limited

PROJECT 80-96-G

TABLE 5 SHEET 8

WATER ANALYSIS RESULTS

LOCATION HALTON HILLS LANDFILL

REMARKS BH-4 Standpipe 11

PROPERTY		Oct. 1980	Dec. 1980	Jan. 1981	Apr.7 1981	May 22 1981	Oct.14 1981	Nov.20 1981				
CONDUCTIVITY μMHOS CM		2,500	1,700		1850	2410	2325	2350				
pH		7.0	7.3				7.1	6.9				
HARDNESS ($CaCO_3$)			737		605	720	680	932				
ALKALINITY ($CaCO_3$)			797				829	1079				
CHLORIDES (Cl)		299	193		308	452	326	323				
SULPHATES (SO_4)		21	67		60	106	63	21				
PHOSPHOROUS AS P	Total			BROKEN IN TRANSIT	.04		1.7	.40				
	Soluble				.02							
NITROGEN (N)	Total Kjeldahl	26	2.6		3.9	9.0	8.0	33				
	Free Ammonia	13	1.3		.2	5.2	4.9	28				
	Nitrite	.01	.01		.03	.02	.01	.18				
	Nitrate	<.1	.1		2.8	.1	.1	.8				
METALS	Potassium (K)		4.9				14.3	30.4				
	Magnesium (Mg)		48				49	74				
	Calcium (Ca)		216				192	251				
	Sodium (Na)		160				243	172				
	Iron (Fe)	316	74		32	80	420	23				
BOD		28	6.0		8	46	12	28				
COD		360	71		61	81	140	170				
Phenol (ppb)			1		1	1						

NOTE: concentrations in p.p.m. unless otherwise noted.

Gartner Lee Associates Limited

PROJECT 80-96-G

TABLE 5 SHEET 9

WATER ANALYSIS RESULTS

LOCATION HALTON HILLS LANDFILL

REMARKS BH-5 Piezometer 1

PROPERTY		Oct. 1980	Dec. 1980	Jan. 1981	Apr.7 1981	May 22 1981	Oct.14 1981	Nov.20 1981				
CONDUCTIVITY μMHOS CM		2125	2,000		2200	2060	1975	1975				
pH		7.6	7.3				7.1	7.7				
HARDNESS ($CaCO_3$)			979		937	960	960	854				
ALKALINITY ($CaCO_3$)			669				714	318				
CHLORIDES (Cl)		392	275		267	259	300	394				
SULPHATES (SO_4)		280	106		120	100	180	290				
PHOSPHOROUS AS P	Total			BROKEN IN TRANSIT	.04		.50	.08				
	Soluble				.02							
NITROGEN (N)	Total Kjeldahl	1.2	1.4		1.6	2.2	2.6	1.2				
	Free Ammonia	0.2	.3		.2	0.5	.7	.2				
	Nitrite	.01	.01		.01	.02	.01	.01				
	Nitrate	<.1	<.1		.2	<.1	.1	<.1				
METALS	Potassium (K)		8.6				10	7.5				
	Magnesium (Mg)		78				80	72				
	Calcium (Ca)		264				252	224				
	Sodium (Na)		116				126	147				
	Iron (Fe)	15	11		12.0	11.2	47	1.6				
BOD		2	4.0		4	22	15	.6				
COD		70	110		65	63	120	20				
Phenol (ppb)			1		<1	<1						

NOTE: concentrations in p.p.m. unless otherwise noted.

Gartner Lee Associates Limited

PROJECT 80-96-G

TABLE 5 SHEET 10

WATER ANALYSIS RESULTS

LOCATION HALTON HILLS LANDFILL

REMARKS BH-5 Standpipe 11

PROPERTY		Oct. 1980	Dec. 1980	Jan. 1981	Apr.7 1981	May 22 1981	Oct.14 1981	Nov.20 1981				
CONDUCTIVITY μMHOS/CM.		1900	2360		3100	2850	2600	1975				
pH		7.1	7.3				6.9	7.1				
HARDNESS ($CaCO_3$)			1120		1153	1111	960	526				
ALKALINITY ($CaCO_3$)			1210				1339	758				
CHLORIDES (Cl)		289	259		336	372	327	287				
SULPHATES (SO_4)		56	66	BROKEN IN TRANSIT	13	10	33	77				
PHOSPHOROUS AS P	Total				.04		4.4	.55				
	Soluble				.02							
NITROGEN (N)	Total Kjeldahl	6.0	20		29	31	27	6.5				
	Free Ammonia	2.0	12		3.2	22	17	4.6				
	Nitrite	<.01	1.3		.02	.01	.20	.01				
	Nitrate	<.1	<.1		.2	.1	1.6	<.1				
METALS	Potassium (K)		21.8				27	7.6				
	Magnesium (Mg)		78				102	9				
	Calcium (Ca)		320				216	195				
	Sodium (Na)		176				208	198				
	Iron (Fe)	150	96		45	97	95	55				
BOD		2	270		18	110	50					
COD		100	480		155	395	310	90				
Phenol (ppb)			1		5	2						

NOTE: concentrations in p.p.m. unless otherwise noted.

Gartner Lee Associates Limited

PROJECT 80-96-G

TABLE 5 SHEET 11

WATER ANALYSIS RESULTS

LOCATION HALTON HILLS LANDFILL

REMARKS BH-6 Piezometer 1

PROPERTY		Oct. 1980	Dec. 1980	Jan. 1981	Apr.7 1981	May 22 1981	Oct.14 1981	Nov.20 1981				
CONDUCTIVITY μMHOS/CM		1500	3100	3900	4450	4190	6000	4300				
pH		7.2	7.2	7.0			7.3	7.3				
HARDNESS ($CaCO_3$)			1097		1328	1390	1750	1401				
ALKALINITY ($CaCO_3$)			328				782	621				
CHLORIDES (Cl)		176	217	565	532	528	943	622				
SULPHATES (SO_4)		335	1080	1320	1200	1120	1650	1380				
PHOSPHOROUS AS P	Total				.20		.34	.34				
	Soluble				.04							
NITROGEN (N)	Total Kjeldahl	2.0	3.0	4.4	5.4	5.0	4.8	4.6				
	Free Ammonia	0.4	1.5	2.8	.1	4.4	3.6	3.2				
	Nitrite	.22	.01	.01	.05	.02	.02	.01				
	Nitrate	.1	<.1	<.1	.3	<.1	<.1	.1				
METALS	Potassium (K)		23.8				32.6	34				
	Magnesium (Mg)		72				141	90				
	Calcium (Ca)		320				468	412				
	Sodium (Na)		415				820	660				
	Iron (Fe)	88	3.2	5.2	6.0	15	6.5	2.6				
BOD		20	44	76	60	32	82	55				
COD		680	440	380	380	385	230	250				
Phenol (ppb)			1		64	22						

NOTE: concentrations in p.p.m. unless otherwise noted.

Gartner Lee Associates Limited

PROJECT 80-96-G

TABLE 5 SHEET 12

WATER ANALYSIS RESULTS

LOCATION HALTON HILLS LANDFILL

REMARKS BH-6 Standpipe 11

PROPERTY		Oct. 1980	Dec. 1980	Jan. 1981	Apr.7 1981	May 22 1981	Oct.14 1981	Nov.20 1981				
CONDUCTIVITY μMHOS/CM.		1460	1430	1550	1550	1490	1410	1250				
pH		7.0	6.9	6.7			7.0	7.0				
HARDNESS ($CaCO_3$)			835		855	796	800	742				
ALKALINITY ($CaCO_3$)			750				1683	639				
CHLORIDES (Cl)		88	86	92	97	119	95	92				
SULPHATES (SO_4)		25	28	20	16	21	86	87				
PHOSPHOROUS AS P	Total				1.0		6.8	.08				
	Soluble				.02							
NITROGEN (N)	Total Kjeldahl	3.0	3.0	1.2	5.0	2.2	5.5	.8				
	Free Ammonia	<.1	<.1	<.1	.1	0.2	0.4	.2				
	Nitrite	<.01	.01	.02	.01	.01	.01	<.01				
	Nitrate	<.1	<.1	<.1	.1	.1	.1	<.1				
METALS	Potassium (K)		4.8				5.4	3.6				
	Magnesium (Mg)		77				75	68				
	Calcium (Ca)		208				196	186				
	Sodium (Na)		38				37	33				
	Iron (Fe)	67	38		42	47	61	37.5				
BOD		44	94	60	70	50	155	18				
COD		260	160	120	160	75	460	30				
Phenol (ppb)			1		22	1						

NOTE: concentrations in p.p.m. unless otherwise noted.

Gartner Lee Associates Limited

PROJECT 80-96-G

TABLE 5 **SHEET** 13

WATER ANALYSIS RESULTS

LOCATION HALTON HILLS LANDFILL **REMARKS** Leachate Collection System - Pump House 1

PROPERTY		Feb.26 1981	Oct.14 1981	Nov.20 1981								
CONDUCTIVITY μMHOS CM		3940	4075	3325								
pH			7.5	7.32								
HARDNESS ($Ca\ CO_3$)			980	1028								
ALKALINITY ($Ca\ CO_3$)			1835	1687								
CHLORIDES (Cl)		372	463	390								
SULPHATES (SO_4)		38	15	13								
PHOSPHOROUS AS P	Total	.5	.9	.62								
	Soluble	.02										
NITROGEN (N)	Total Kjeldahl	105	140	120								
	Free Ammonia	97	130	120								
	Nitrite	.02	.03	.04								
	Nitrate	.1	<.1	.2								
METALS	Potassium (K)		138	20.6								
	Magnesium (Mg)		134	116								
	Calcium (Ca)		172	220								
	Sodium (Na)		350	265								
	Iron (Fe)	240	64	83								
BOD		2250	240	620								
COD		3000	550	980								
Suspended Solids		455										

NOTE: concentrations in p.p.m. unless otherwise noted.

Gartner Lee Associates Limited

Surface Water Chemical Analyses

ONTARIO MINISTRY Of The ENVIRONMENT

PROVINCIAL WATER QUALITY OBJECTIVES[1]

And DRINKING WATER QUALITY CRITERIA[2]

For The SUBSTANCES ANALYZED

Substance	Concentration
pH	6.5 - 8.5[1]
Dissolved Oxygen (DO)	>4 mg/L (minimum) dependent on temperature
Chloride (Cl)	250 mg/L[2]
Sulphate (SO_4)	250 mg/L[2]
Total Phosphorous (P)	0.03 mg/L[1]
Free Ammonia (N)	dependent on pH and temperature
Nitrate (N)	10 mg/L[2]
Iron (Fe)	0.3 mg/L[2]
Phenols	0.001 mg/L[2]

PROJECT 80-96-G

TABLE 6 SHEET 1

WATER ANALYSIS RESULTS

LOCATION HALTON HILLS LANDFILL

REMARKS SW 1 Credit River (Upstream)

PROPERTY		Oct. 1980	Dec. 1980	Feb. 1981	Apr.8 1981	May 21 1981	Oct.14 1981	Nov.20 1981	1981 Mean			
CONDUCTIVITY μMHOS/CM.		520	495	442	520	480	510	510	492			
pH		8.3	8.1	7.7			8.1	8.2	8.2			
Temperature		4°C	1°C	-								
Dissolved Oxygen		10	11	-								
CHLORIDES (Cl)		28	24	21	25	23	22	18	22			
SULPHATES (SO_4)		38	-	30	32	29	28	34	31			
PHOSPHOROUS AS P	Total	.02	.08	.12	.04	.04	.10	.06	.07			
	Soluble	<.02	<.02	<.02	<.02	.04	<.02	<.02	<.02			
NITROGEN (N)	Total Kjeldahl	.6	.8	.8	.4	.4	.4	.6	.5			
	Free Ammonia	<.1	.2	.2	<.1	<.1	<.1	<.1	<.1			
	Nitrite	<.01	.01	<.01	.01	.01	<.01	.01	.01			
	Nitrate	.8	1.1	.7	.8	.4	.5	.8	.6			
	Potassium (K)						1.7	2.1	1.9			
	Magnesium (Mg)											
	Alkalinity	-	223	-			220	219	220			
	Hardness	-	294	220	252	242	256	264	247			
	Iron (Fe)	.56	2.5	1.92	.2	.14	.14	.32	.54			
BOD		.6	1.8	1.4	.8	.2	1.0	.8	.8			
COD		<20	32	16	24	23	10	10	17			
Phenol				<1	<1	<1			<1			

NOTE: concentrations in p.p.m. unless otherwise noted.

Gartner Lee Associates Limited

PROJECT 80-96-G

TABLE 6 SHEET 2

WATER ANALYSIS RESULTS

LOCATION HALTON HILLS LANDFILL

REMARKS SW 2 CREDIT RIVER (UPSTREAM)

PROPERTY		Oct. 1980	Dec. 1980	Feb. 1981	Apr.8 1981	May 21 1981	Oct.14 1981	Nov.20 1981	1981 Mean			
CONDUCTIVITY μMHOS CM		500	520	435	520	480	520	500	491			
pH		8.3	8.1	8.0			8.2	8.3	8.2			
Temperature		$4^{o}C$	$1^{o}C$									
Dissolved Oxygen		9	10									
CHLORIDES (Cl)		24	24	21	24	22	20	24	22			
SULPHATES (SO_4)		30	-	30	31	31	28	32	30			
PHOSPHOROUS AS P	Total	.02	.08	.10	.02	.04	.08	.04	.06			
	Soluble	<.02	<.02	<.02	<.02	.04	<.02	<.02	<.02			
NITROGEN (N)	Total Kjeldahl	.6	.6	.6	.4	.2	.6	.6	.5			
	Free Ammonia	.1	.1	<.1	<.1	<.1	<.1	<.1	<.1			
	Nitrite	<.01	.02	<.01	.01	.01	<.01	.01	.01			
	Nitrate	.7	1.2	.6	.8	.4	.4	.8	.6			
	Potassium (K)						1.7	2.0	1.9			
	Magnesium (Mg)											
	Alkalinity	-	223	-			221	219	220			
	Hardness	-	276	225	252	242	254	264	247			
	Iron (Fe)	.54	2.5	2.15	.20	.47	.27	.30	.68			
BOD		.6	1.8	1.8	.8	2.0	1.2	1.0	1.4			
COD		<20	23	18	19	<10	12	15	15			
Phenol (ppb)		-	-	<1	<1	<1			<1			

NOTE: concentrations in p.p.m. unless otherwise noted.

Gartner Lee Associates Limited

PROJECT 80-96-G

TABLE 6 SHEET 3

WATER ANALYSIS RESULTS

LOCATION HALTON HILLS LANDFILL

REMARKS SW 3 Credit River (downstream)

PROPERTY		Oct. 1980	Dec. 1980	Feb. 1981	Apr.7 1981	May 21 1981	Oct.14 1981	Nov.20 1981	1981 Mean			
CONDUCTIVITY μMHOS CM		505	525	432	520	485	505	500	488			
pH		8.3	8.2	8.1			8.3	8.3	8.3			
Temperature		$4^{o}C$	$1^{o}C$	-								
Dissolved Oxygen		11	10	-								
CHLORIDES (Cl)		24	27	22	24	22	20	22	22			
SULPHATES (SO_4)		30	-	30	31	28	28	32	30			
PHOSPHOROUS AS P	Total	.02	.08	.10	.02	.02	.06	.04	.05			
	Soluble	<.02	<.02	<.02	<.02	<.02	<.02	<.02	<.02			
NITROGEN (N)	Total Kjeldahl	.6	.8	.8	.4	.1	.4	.6	.5			
	Free Ammonia	<.1	.1	<.1	<.1	<.1	<.1	<.1	<.1			
	Nitrite	<.01	.02	.01	.01	.01	<.01	.01	.01			
	Nitrate	.8	1.2	.6	.8	.4	.4	.8	.6			
	Potassium (K)						1.7	2.1	1.9			
	Magnesium (Mg)							19				
	Alkalinity	-	227	-			221	219	220			
	Hardness	-	280	220	250	240	256	261	245			
	Iron (Fe)	.48	3.0	2.2	.29	.42	.59	.34	.77			
BOD		.6	2.0	2.5	.8	1.4	1.2	1.0	1.4			
COD		<20	36	20	19	15	32	12	20			
Phenol		-		<1	<1	<1			<1			

NOTE: concentrations in p.p.m. unless otherwise noted.

Gartner Lee Associates Limited

PROJECT 80-96-G

TABLE 6 SHEET 4

WATER ANALYSIS RESULTS

LOCATION HALTON HILLS LANDFILL

REMARKS SW 4 Credit River (downstream)

PROPERTY		Oct. 1980	Dec. 1980	Feb. 1981	Apr.7 1981	May 21 1981	Oct.14 1981	Nov.20 1981	1981 Mean			
CONDUCTIVITY µMHOS CM		500	498	429	520	465	500	500	483			
pH		8.2	8.2	8.1			8.3	8.3	8.2			
Temperature		$4^{o}C$	$1^{o}C$	-								
Dissolved Oxygen		10	11	-								
CHLORIDES (Cl)		23	25	21	24	23	20	21	22			
SULPHATES (SO_4)		30	-	30	31	28	28	32	30			
PHOSPHOROUS AS P	Total	.02	.04	.14	.02	.04	.08	.02	.06			
	Soluble	<.02	<.02	<.02	<.02	<.02	<.02	.06	.03			
NITROGEN (N)	Total Kjeldahl	.6	.6	.8	.4	.2	.4	.6	.5			
	Free Ammonia	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1			
	Nitrite	<.01	.01	<.01	.01	.01	.01	.01	.01			
	Nitrate	.7	1.2	2.2	.8	.3	.4	.8	.9			
	Potassium (K)						1.7	2.1	1.9			
	Magnesium (Mg)							19				
	Alkalinity	-	223	-			220	219	220			
	Hardness	-	258	226	251	238	256	264	247			
	Iron (Fe)	.50	1.4	2.3	.25	.52	.40	.31	.76			
BOD		.4	1.6	1.4	.8	1.4	1.0	1.2	1.2			
COD		<20	27	24	<10	15	18	11	16			
Phenols		-	-	<1	<1	<1			<1			

NOTE: concentrations in p.p.m. unless otherwise noted.

Gartner Lee Associates Limited

PROJECT 80-96-G

TABLE 6 SHEET 5

WATER ANALYSIS RESULTS

LOCATION HALTON HILLS LANDFILL

REMARKS SW 5 Credit River (downstream)

PROPERTY		Oct. 1980	Dec. 1980	Feb. 1981	Apr.7 1981	May 21 1981	Oct.14 1981	Nov.20 1981	1981 Mean			
CONDUCTIVITY μMHOS CM		500	496	419	520	460	505	500	481			
pH		8.3	8.2	8.1			8.4	8.3	8.3			
Temperature		$4^{o}C$	$1^{o}C$	-								
Dissolved Oxygen		11	11	-								
CHLORIDES (Cl)		24	24	26	24	23	20	20	23			
SULPHATES (SO_4)		29	-	30	31	28	25	32	29			
PHOSPHOROUS AS P	Total	.02	.04	.10	.04	.04	.02	.02	.04			
	Soluble	<.02	<.02	<.02	.04	<.02	<.02	.04	.03			
NITROGEN (N)	Total Kjeldahl	.6	.4	.8	.4	.4	.6	.6	.6			
	Free Ammonia	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1			
	Nitrite	<.01	.01	<.01	.01	.01	<.01	.01	.01			
	Nitrate	.7	1.2	2.2	.8	.3	.4	.8	.9			
	Potassium (K)						1.7	2.3	2.0			
	Magnesium (Mg)							19				
	Alkalinity	-	215	-			218	218	218			
	Hardness	-	275	227	251	236	252	263	246			
	Iron (Fe)	.42	1.3	2.14	.29	.51	.20	.25	.68			
BOD		1.8	1.8	1.4	.6	1.4	1.0	1.2	1.1			
COD		<20	42	14	17	<10	10	17	14			
Phenols		-		<1	<1	<1			<1			

NOTE: concentrations in p.p.m. unless otherwise noted.

Gartner Lee Associates Limited

PROJECT 80-96-G

TABLE 6 SHEET 6

WATER ANALYSIS RESULTS

LOCATION HALTON HILLS LANDFILL

REMARKS Storm Drain Outlet (Below Landfill)

PROPERTY		May 21 1981	Oct.14 1981	1981 Mean	Mar.22, 1982							
CONDUCTIVITY μMHOS CM.		4050	4060	4055	850							
pH			7.6		7.6							
HARDNESS ($CaCO_3$)		980	750	865	233							
ALKALINITY ($CaCO_3$)			770	770	179							
CHLORIDES (Cl)		735	910	823	133							
SULPHATES (SO_4)		94	49	72	48							
PHOSPHOROUS AS P	Total	.32	.46	.39	.22							
	Soluble	<.02	<.02	<.02	.04							
NITROGEN (N)	Total Kjeldahl	65	41	53	3.0							
	Free Ammonia	60	39	50	1.8							
	Nitrite	<.01	.08	.05	.12							
	Nitrate	<.1	.4	.3	.7							
METALS	Potassium (K)		50		6.8							
	Magnesium (Mg)		80									
	Calcium (Ca)		168									
	Sodium (Na)		530		85							
	Iron (Fe)	58	7.4	32.7	2.4							
BOD		160	11	86	3.5							
COD		265	110	188	35							
Phenol (ppb)		15										

NOTE: concentrations in p.p.m. unless otherwise noted.

Gartner Lee Associates Limited

Surface Water Bacteriological Analyses

HALTON HILLS LANDFILL - Surface Water Bacteriological Analysis
(Results in counts per 100 ml)

Project: 80-96-G

SW1 - Credit River (Upstream)

	August 1979	December 1980	February 1981	April 7, 1981	May 21, 1981	October 14, 1981	November 20, 1981	1981 Geometric Mean				
Total Coliforms	>2800	1400	1500	240	1300	210	4700	857				
Coliform Background	-	2600	7800	580	14000	3200	5400	4054				
Fecal Coliform	310	A80	A20	<10	<10	A20	A80	20				
Fecal Strep.	490	220	A50	A30	A10	60	220	40				
Pseudomonas Aeruginosa	>10	A10	>10	< 4	< 4	< 4	<10	<10				
Pseudomonas Background	-	10	>10	< 4	24	< 4	<10	<10				

HALTON HILLS LANDFILL - Surface Water Bacteriological Analysis
Project: 80-96-G (Results in counts per 100 ml)
SW2 - Credit River (Upstream)

Table 7. Sheet 2

	August 1979	December 1980	February 1981	April 7, 1981	May 21, 1981	October 14, 1981	November 20, 1981	1981 Geometric Mean				
Total Coliform	>2900	100	1200	520	5200	190	5300	1267				
Coliform Background	-	250	3000	2140	8500	2800	4200	3643				
Fecal Coliform	540	110	A10	<10	A10	A10	A80	15				
Fecal Strep	500	300	A50	<10	A50	A40	A80	38				
Pseudomonas Aeruginosa	< 10	A10	<10	< 4	< 4	< 4	A10	< 10				
Paeudomonas Background	-	20	<10	< 4	8	< 4	<10	< 10				

HALTON HILLS LANDFILL - Surface Water Bacteriological Analysis
Project: 80-96-G (Results in counts per 100 ml)
SW3 - Credit River (Downstream)

	August 1979	December 1980	February 1981	April 7, 1981	May 21, 1981	October 14, 1981	November 20, 1981	1981 Geometric Mean				
Total Coliform	28,000	1200	2000	460	4100	160	1700	1005				
Coliform Background	-	38000	4000	1180	6300	8300	5500	4232				
Fecal Coliform	1350	100	A10	<10	A20	A10	A30	14				
Fecal Strep	2700	250	110	A10	<10	A40	290	42				
Pseudomonas Aeruginosa	380	A10	>10	< 4	< 4	< 4	<10	<10				
Pseudomonas Background	-	20	>10	< 4	4	< 4	<10	<10				

HALTON HILLS LANDFILL - Surface Water Bacteriological Analysis
Project: 80-96-G (Results in counts per 100 ml)
SW4 - Credit River (Downstream)

	August, 1979	December, 1980	February, 1981	April 17, 1981	May 21, 1981	October 14, 1981	November 20, 1981	1981 Geometric Mean					
Total Coliform	12000	A500	1500	A180	1300	A600	1120	749					
Coliform Background	-	1600	3900	900	4200	8300	2900	3236					
Fecal Coliform	920	A70	< 10	< 10	< 10	A10	120	16					
Fecal Strep.	630	270	140	A 10	140	A50	140	67					
Pseudomonas Aeruginosa	290	A50	< 10	< 4	< 4	< 4	< 10	< 10					
Pseudomonas Background	-	10	< 10	< 4	< 4	< 4	< 10	< 10					

HALTON HILLS LANDFILL - Surface Water Bacteriological Analysis
(Results in counts per 100 ml)
SW5 - Credit River (Downstream)

Table: 7 Sheet: 5

	December 1980	February 1981	April 7, 1981	May 21, 1981	October 14, 1981	November 20, 1981	1981 Geometric Mean						
Total Coliforms	1900	1300	A180	1000	150	1800	576						
Coliform Background	2000	3400	900	3200	5800	2800	2756						
Fecal Coliform	A30	A10	<10	A20	A20	200	24						
Fecal Strep.	340	A50	<10	A20	A40	150	36						
Pseudomonas Aeruginosa	<10	<10	<4	<4	<4	<10	<10						
Pseudomonas Background	<10	<10	<4	<4	<4	<10	<10						

HALTON HILLS LANDFILL - Surface Water Bacteriological Analysis
Project: 80-96-G (Results in counts per 100 ml)
Storm Sewer Outfall Below Landfill

Table: 7 Sheet: 6

	May 21 1981	Oct. 14 1981	1981 Geometric Mean	March 22, 1982									
Total Coliforms	>15000	19000	16882	1100									
Coliform Background	>15000	530000	89162	26000									
Fecal Coliform	<20	A30	24	<10									
Fecal Strep.	720	620	668	100									
Pseudomonas Aeruginosa	<20	A20	<20	<10									
Pseudomonas Background	<20	<10	<20	<10									

APPENDIX III

Table: 8 Types and numbers of bottom fauna organisms and fish collected from artificial substrates at four stations in the Credit River in the vicinity of the Halton Hills Landfill - August, September, 1981.

ORGANISM	STATION 1	2	3	4	
STONEFLIES					
Acroneuria	1	1	1	1	
Paragnetina	9	15	12	60	
Pteronarcys		1		1	
Taeniopteryx		1			
FISHFLIES					
Chauliodes	1				
Sialis	1				
MAYFLIES					
Caenis			2	1	
Isonychia	1	1	4		
Stenonema	7	6	27	8	
CADDISFLIES					
Cheumatopsyche	45	27			
Helicopsyche			2		
Hydropsyche	122	123	135	42	
Setodes			1		
BEETLES					
Unidentified adults	8	1	1	8	
Elmidae	1			1	
Limnichidae				1	
Psephenidae		1			
TRUEFLIES					
Chironomidae pupa	1				
larvae	3	5	1	2	
Empididae		1			
Rhagionidae	1		1		
Tabanidae	4	2		5	
Tipulidae	1				
MITES			1		
ISOPODS					
Asellus (terrestrial sow bug)	1			1	

ORGANISM	STATION 1	2	3	4	
AMPHIPODS					
Crangonyx		1			
Gammarus	3			2	
Hyalella azteca	1	1			
CRAYFISH					
Cambarus	1	2	2		
Orconectes propinquus	3	2		1	
SNAILS					
Unidentified	1				
Ferrissia				2	
Helisoma		1			
Physa			1	2	
LEECHES				2	
SLUDGEWORMS				2	
FLATWORMS				1	
TOTAL NUMBERS	207	191	190	134	
TOTAL NUMBER TAXA	19	17	13	17	